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FEDERAL EFFORTS IN SCIENCE AND MATHEMATICS EDUCATION

HEARING

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

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SPECIAL HEARING

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FEDERAL EFFORTS IN SCIENCE AND MATHEMATICS EDUCATION

THURSDAY, JUNE 28, 1990

U.S. SENATE,
SUBCOMMITTEE ON VETERANS AFFAIRS, HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES,
COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 9:39 a.m., in room SD–192, Dirksen Senate Office Building, Hon. Barbara A. Mikulski (chairman) presiding.

Present: Senators Mikulski, Kerrey, Garn, Grassley, and D'Amato.

EXECUTIVE OFFICE OF THE PRESIDENT

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

STATEMENT OF D. ALLAN BROMLEY, DIRECTOR

OPENING REMARKS OF SENATOR MIKULSKI

Senator MIKULSKI. The subcommittee will come to order.

Today we are here to seize our future—to get America back on the track of scientific literacy. This is a challenge that goes beyond next year's budget cycle or budget summit, and it is going to require creativity and coordination. A new century is coming and a new millennium. When we stop to think about how many days before it will be New Year's Eve 2000, we are 3,473 days away, and we've got to make every day and every minute count.

We need to get our kids and our workplace ready for the 21st century. We need concrete strategies that lead to real solutions, not more of the same. We know the signs of the problem. From classrooms to board rooms and in this committee room, we have heard statistics and seen predictions.

As appropriators, we are now ready for action to coordinate and to have action on these issues. When people do standardized tests around the world, our kids do not finish first. They do not even finish in the upper half.

It is not just the whiz kid subjects like astrophysics. It is the basics. One-third of our Nation believes you can make radioactive milk safe by boiling. Less than one-half know that the Earth revolves around the Sun once a year. Basic scientific facts that are important just to deal with day-to-day life in the 21st century are lacking.

Now, why an education hearing here in the Subcommittee on VA, HUD, and Independent Agencies appropriations? We are not here to be substitute authorizers. But we believe in this committee that education is everybody's commitment, and education should be a prism through which every single committee of this U.S. Congress should look, regardless of the nature of it, and that every one of us has a role in education.

The portfolio of this subcommittee has a very unique role, particularly in the area of science and math education. Agencies like NSF are charged with getting our students ready. Others, like NASA and EPA, will need those scientists and technicians to carry out their 21st century missions. Almost all of the civilian spending on scientific research and development, except for the Department of Energy, is on our books. I include the VA when we talk about science education, for it is not only the Ph.D.'s that will work at NASA or the master's degree that will work at EPA who are important. It is also the lab technician in our VA hospitals, it is the radiology technician, it is the nurse, and it is the doctor. And their interest in science and technology starts in elementary school.

So that is why we seek to focus science education. Today we want to know what are the administration's goals, how are we going to bring about a permanent and sustained reform. We are going to examine the breadth of the problem from parents, teachers, business, and through to the research community.

Today we bring together the people who can make a difference. Agencies like the NSF, NASA, and EPA who will need and produce the scientists and technicians to carry on in the 21st century.

Our hope is that we will see a comprehensive strategy to address this challenge. Let me wrap up my statement by saying that last year this subcommittee asked Dr. Bromley to begin developing a strategy by bringing together the National Science Foundation and the Department of Education. He set up a FCCSET coordinating committee on science education, chaired by someone whom I admire tremendously, Secretary Watkins.

Today we are going to hear what the administration has done since then and what they intend to do. Our witnesses will tell us about some of the new programs in place, but I want to hear how they are going to coordinate those efforts to maximize results, because we need to work together.

How will we get information about these creative programs out to the 16,000 school districts? Effective education programs sitting on shelves in some warehouse does not help the teacher or the child.

And then what is the bottom line? How can we spend our money smarter? We are going to be looking at the work force need. We are going to be looking at how we can recruit to solve the teacher shortage. We know we need to recruit them; we know we need to retain them.

What about the students who have perfect attendance and not perfect SAT's? Well, this is one Senator who says we have got to say "Yes" to the kids who say "No." For all those wonderful kids every day who get up there and do their homework instead of doing drugs, we have got to say "Yes" to them and create an opportunity structure for them.

Our panelists have a big task and I look forward to working with you. I am going to have a longer statement that I ask unanimous consent to go into the record. But I really look forward to this hearing with a great deal of pleasure, and I am so happy that I have such a turnout from my colleagues on the committee: my ranking minority, Senator Garn, who has been persistent in this area for a number of years, and the newest member of the committee, Senator Bob Kerrey.

[The statement follows:]

STATEMENT OF SENATOR MIKULSKI

The Subcommittee will come to order.

Today, we are here to seize our future -- to get America back on the track of scientific literacy. This is a challenge that goes beyond next year's budget cycle or budget summit. It will require creativity, commitment, and coordination.

A new century is coming. A new millenium. We have 3473 days to get our kids and our workers ready for the 21st century. We need concrete strategies that lead to real solutions -- not more of the same.

We know the size of the problem. From the classrooms to the boardrooms, and in this committee room, we have heard the statistics and seen the predictions. When they give standardized tests around the world, our kids don't finish first -- they don't even finish in the upper half. It's not just the whiz kid subjects like astrophysics -- it's the basics. A third of our nation believes you can make radioactive milk safe by boiling it. Less than half know that the earth revolves around the sun once a year. Basic scientific facts that will be important just to deal with day-to-day life in the 21st century.

My questions are: What are we doing to prepare? What is the administration strategy? We know what the goal is -- now how are we going to get from here to there? To create radical, permanent, and sustained reform, we must involve parents and teachers, business and government. And most of important of all, how can we keep kids interested?

Earlier this year, I spent a week in Maryland finding out about programs in my state that are encouraging students in math and science. Those kids were enthusiastic, and doing amazing things in magnet schools, and on computers. Some were working at their own pace, and some were working with scientists from nearby companies. I saw commitment and excitement. I want to see the same energy and innovation in our nationwide strategy for the future.

Today, we've brought together the people who can make a difference. This subcommittee has a unique role in scientific education. Agencies like the National Science Foundation are charged with getting our students ready. Others, like NASA and EPA, will need those scientists and technicians to carry out their 21st century missions. And almost all of the civilian spend-

ing on scientific research and development, except for the Department of Energy, is on our books.

My hope is that we will see a comprehensive strategy to address this challenge. Last year, this subcommittee asked Dr. Bromley to begin developing that strategy by bringing together NSF and the Department of Education. He set up a FCCSET ("FIX IT") Committee on science education, chaired by Secretary Watkins. Today we will hear what the administration has done since then, and what they intend to do down the line.

Our witnesses will tell us about some of the good programs that are already in place. But I also want to hear how they are coordinating their efforts to maximize results. How will we get information about these creative models and innovative ideas out to our nation's 16,000 school districts? And what's the bottom line -- how can we spend our money smarter?

By the year 2000, NSF estimates we will need more than 865,000 more BS and PhD degrees in math and science than we will have. And we will be short 300,000 Math and Science teachers. To prepare our students, we must retool and refresh those teachers.

We will have to retain the teachers we have, and recruit the ones we will need.

And while we're looking to recruit new teachers, let's also look at recruiting some new students to math and science. Because in the global economic competition of the next century, we can't afford to start from behind. And we can't afford to lose any of our talent along the way.

What about the students who have perfect attendance but not perfect SAT's? We need to say yes to those kids who do their homework, who say yes to school, and say no to drugs, no to teenage pregnancy, no to dropping out. We need doctors in the labs and engineers in the field, but the technicians at NIH, at Goddard, and at the Department of Energy in Rockville are just as important. Let's encourage those hard working kids to look beyond math and science literacy to science and technology careers.

We need to change the role models to match the changes in demographics. The workforce of the next century will rely on more minorities and more women. Today, only 2.6% of our nation's scientists and engineers are black. When kids are asked what their

image of a scientist is, they describe a white man in a white coat. We need to show them the Sally Rides and the George Washington Carvers.

Our panels today have a big task. I thank all of our witnesses for joining us. Let's put together a strategy that will transform the economic destiny of our country for the new century. Let's join the partnership, and let's get started.

REMARKS OF SENATOR GARN

Senator MIKULSKI. Senator Garn, do you want to say anything before we begin?

Senator GARN. Yes, I certainly do, Madam Chair. First of all, I want to sincerely compliment you for holding this hearing, for your very forthright statement, which certainly clearly delineates the challenge confronting our youth and the Nation to assume prosperity and education in the next century.

I suppose this is one of my biggest frustrations, is the lack of discussion about education. Mr. Bloch has heard this speech many times and he can go to sleep if he would like to. My frustration comes because we concentrate so much on dramatic events—the shuttle, space station, Hubble Telescope, and I certainly have been enthusiastic in my advocacy of those programs.

But on the other hand, the frustration comes from the fact that we are not looking at basic science, math, and science education in this country. There are two sides of the coin to me having going into space. On the one side, it has allowed me to have some personal knowledge that has been very helpful and brought some attention to space.

But on the other hand, most of the press stories seem to think all I am interested in is the space shuttle, space station, bigger projects. For a long time before I ever had that opportunity to fly on the shuttle, my interest was far, far broader.

I spent just as much time over the years looking at the National Science Foundation, at their funding, and many other aspects of science, because of my very great concern that we are losing our technological edge in this world. We have always been able to have superiority because of our superior science and our technological advances. We have never been able to compete with our friends and enemies in terms of quantity of things, but we have had the superior science.

I am really very, very concerned about the lack of math and science teachers in this country. I know the stories from some of my

own children going to math class and having the teacher tell me that, well, she is sorry, she is a chemistry teacher, but she has to fill in, and she reads two or three chapters ahead of the algebra students, and so on.

You will find in some schools where they have got a math teacher who is teaching biology because they could not find a biology teacher. And our children seem to want to take all of the easy classes—sunflowers and early morning bird calls—but do not burden themselves with taking math and science.

So I look to the year 2000 and wonder where we will be as a world power versus the Soviet Union, versus Germany, versus Japan, versus other countries, if we do not do something about this basic educational system in math and science. So I cannot tell you, Madam Chair, how much I appreciate your interest in this, your statement, your willingness to hold this hearing.

Although it may not be directly within our jurisdiction, this is certainly something that I think this subcommittee ought to be aware of because of the types of programs that we deal with, and to do everything we can to see if we might improve this situation and make certain that we are getting more of our young people interested in science.

I do have the opportunity to go show my space film at a lot of schools, and it is just amazing to me. I doubt very much that on any other subject, just as an example of how I think we can stimulate our young people to be much more interested in school in general, because if you try and go to a kindergarten through sixth grade and hold their attention for more than 5 minutes on any subject, it is a very difficult process.

But interestingly enough, if you are talking about science in space, even kindergarten kids sitting on the wood floor in the front row so they will be shorter and the bigger kids can see behind them and so on, they listen and they are excited.

So the potential is really there. I do not think it is the children's failing; it is ours. We are just not providing enough incentive and enough help and enough teachers to this area.

So again, Madam Chair, I really thank you for holding this hearing.

Senator MIKULSKI. Thank you, Senator Garn.

Senator Kerrey?

REMARKS OF SENATOR KERREY

Senator KERREY. I also want to compliment you, Madam Chair, for holding the hearing. I think improving science and math education is an extremely difficult and extremely important problem for America to try to solve. I suggest the difficulty of it can be seen in two stories that appeared this morning in the New York Times, one on the Hubble Telescope—the telescope apparently has some defects in the mirror—and the final article in a series of 11 articles that have appeared in the New York Times on the public schools in New York City, this one on P.S. 34.

Both of these problems need to be fixed, and I suspect that the mirror in space will be easier to fix. It is essentially a mechanical problem to determine where the error is and determine how to

manufacture something to correct it, then figure out how to get it in space and fix the mirror and you are in business.

I suspect it is going to be much easier to fix than something that appears to be comparatively smaller, that is P.S. 94, a grade school in New York City. By the way, the problems that this school faces are no different than the problems, for example, in Scotts Bluff, NE. Our rural communities are facing the same sort of thing, young children with problems at home, schoolteachers having difficulties trying to figure out exactly what it is that they're supposed to do.

I spoke with a superintendent in Omaha who is trying to hire for this fall, and it is no surprise to the panel, I suspect, to hear that they are hiring third-grade teachers to teach mathematics at $22,000 a year. Well, you are not going to get much at $22,000 a year.

What you will get are people who are really dedicated to the task, willing to take $22,000 a year even though they could get considerably more going someplace else instead. Or you are going to get someone who couldn't go elsewhere.

It is extremely complicated, extremely difficult. I happen to believe it is going to take considerably more money than we are currently spending to improve the education system, and it will not be that easy.

There are 16,000 schools in America. There are 45 million students in America. There are 60,000 public schools and 40,000 private schools that are all going to be starting operating again in September. Many of them do tutorial work over the summer, trying to do the damage control stuff over the summer, and they need our help.

I appreciate a conversation I had yesterday with Dr. Williams of NSF about this problem. I would just suggest that one of the things that I believe we need to do is to show Americans that, in fact, we can do good science, because increasingly there is the opinion that nothing works, that there is no money, there is no restructuring, that is, in fact, there is nothing that is going to make a difference—in part because an awful lot of people did have lousy experiences in school as well.

So to try to convince the American citizen that something can be done with our public schools, or with our private schools for that matter, is exceedingly more difficult than to convince them that we can fix a mirror that is going around in space.

It seems to me that what we have got to do is come to the task with a tremendous urgency and then bite off something small and show Americans that we can win, and do it quickly, and build upon those successes. Then we say that we are going to try to sustain the effort beyond our own careers in public service and try to do it beyond the election of 1992, beyond the election of 1994, beyond the election of 1996, because we are going to have to sustain this effort for an entire generation.

Again, I really appreciate your holding this hearing, Madam Chair. It gives us an opportunity.

Senator MIKULSKI. Thank you very much.

We are now going to turn to Dr. Bromley, the Director of the Office of Science and Technology Policy, the Advisor to the President on science and tech policy, who set up this strategy team.

Dr. Bromley.

Dr. BROMLEY. Thank you, Madam Chair.

Let me begin by saying how much I too appreciate your continuing interest in this extremely important problem and how much I appreciate the opportunity to come to appear before you this morning.

You have my written testimony that I would request be included in the record.

Senator MIKULSKI. Without objection.

SUMMARY OF THE PROBLEM

Dr. BROMLEY. What I will then do is to very briefly summarize some aspects of the challenge that we face and then turn quickly to the steps that the Federal Government proposes to take.

Unfortunately, Admiral Watkins is attending the funeral of a very close colleague this morning. Secretary Cavazos is traveling on a speaking tour in the West and, unhappily, Deputy Secretary Sanders is attending a family funeral. They have asked me to convey to you, Madam Chair, and to your colleagues on the committee their apologies for not being able to join with us this morning. They would have liked to do so.

Let me then turn to the problem that we share. I think it can be divided into two parts. The first part concerns professionals in science and technology, the scientists and engineers who explore the frontiers of knowledge, add to our technological know-how, and contribute in a central way to the strengthening of our economy.

The second part—much the more difficult part, as Senator Kerrey has already emphasized—concerns the general public, which has a substantial indirect effect on the practice of research and development in this country.

SCIENTIFIC AND TECHNICAL PERSONNEL

If I could turn first to the matter of scientific and technical personnel, we should first note that the technical work force in this country expanded in dramatic fashion in the 1980's. The number of people employed as scientists and engineers in the private sector increased at a rate almost twice that of other categories of workers in the 1980's.

According to the NSF, nearly 5 million people are now employed in the United States as scientists and engineers. I do not believe that it is coincidental that this dramatic expansion of the scientific and technical work force has coincided with the longest peacetime economic period of growth in the Nation's history.

The link between science, technology, and economic growth has been demonstrated repeatedly in this country, and I believe that it is now being confirmed in countries around the world.

I expect the demand for scientists and engineers to continue to grow in the 1990's. Several factors will contribute to this growth; one is, of course, the surge in retirements as the generation of sci-

entists and engineers who were hired in the sixties immediately after the Sputnik launching reaches retirement age.

Current projections indicate—and I would hasten to add that our projections are not as good, Madam Chair, as I believe they can and will be—but current projections indicate that we are going to face increasingly difficult problems meeting the demand for scientists and engineers as we proceed toward the end of this century.

The number of 22-year-olds in the country is dropping, and it will continue to drop well into the 1990's. Furthermore, as we have discussed in previous hearings, fewer and fewer of the young people entering our Nation's colleges and universities are indicating that they plan to specialize in science or technology.

I agree with the statement that all three of you have made this morning, that we must make very special efforts to reach every student in this country. One necessity is that we attract and retain a much larger fraction of women and minority students in science and engineering. The low level of both in this country verges on being scandalous. We do not compare at all with other developed nations, and we cannot afford this wastage of very important talent in the future.

Between now and the year 2000, 65 to 70 percent of the new entrants into the labor force will be women and minorities. The United States trails every other developed nation in the participation of women in science and engineering and in the fraction of minorities in physical sciences and engineering. In fact, the numbers in the latter are so small that they are not significant statistically.

We have to provide much better opportunities for disadvantaged students. They too constitute a vital talent pool.

SCIENTIFIC LITERACY IN THE GENERAL PUBLIC

Before I turn to discussing the steps that the Bush administration has taken to deal with these issues, I want to discuss one other issue, and that is the question of the scientific literacy of the general public. It is my opinion that in a democracy like ours it is absolutely essential that our citizens at least be able to understand the broad issues that confront the Nation, even if they are not going to be able to participate in any direct way in resolving those problems.

Lacking that understanding, there is an all-too-evident tendency to become alienated from the society, and we simply cannot afford that. Literacy, both verbal and numeric, is the foundation, I would submit, on which we must build the future of this Nation, for both the general public and for trained personnel in science and technology.

I believe, too, that the heart of the problem is not in our colleges and universities. Rather, it is in our secondary schools and in our elementary schools, and in some aspects even before elementary school. We cannot realistically expect significant improvement until we make substantial changes at those levels.

ADMINISTRATION ACTIONS

What then is the administration proposing to do? What does the administration have underway? We have taken a number of major

steps that we believe will catalyze the kind of change that I've just discussed.

As you know, the education summit held by the President and the Nation's Governors led to a set of national goals, objectives to be reached by the year 2000. I am happy to see that one-fourth of those goals concerns science and mathematics education.

These goals form a national framework for Federal policy and strategic investments in science, mathematics, and engineering education at all levels. If we are going to achieve these goals—and they are ambitious goals—it will be necessary for all of us to work together and work together effectively.

Teachers, students, industries, universities, States, and local and Federal Government are all involved, and we all have an important role to play. For that reason, Madam Chair, I am particularly delighted to see the interest of your committee because I think that by working together we can make these things happen.

Through the 1991 budget, the President has placed high priority on programs of funding for science and mathematics education. The budget proposes over $1 billion in direct spending in five agencies for science, mathematics, and engineering education, representing a 26-percent increase over fiscal year 1990.

The National Science Foundation and the Department of Education have substantial programmatic responsibility for science, mathematics, and engineering education, with critical supplementary roles played by the Department of Energy, NASA, the National Institutes of Health, the Department of Defense, and other agencies that play important supporting roles.

In my written testimony, I spent some time describing the activities of each of these agencies in the area of science and mathematics education, but in the interest of time I will not discuss that here. Rather, you have present this morning representatives of those agencies who can give you detailed coverage of their respective programs.

What is particularly important is what I view——

Senator MIKULSKI. Dr. Bromley, I am going to have to ask you to start to wrap it up. As fascinating as this is, we have other members and also the second panel.

FCCSET AND PCAST

Dr. BROMLEY [gap in recording]. And that of OSTP and the Federal Coordinating Council, to carry out the coordination and integration of the programs of all the agencies about which we will hear today, into an integrated, coherent national program that is addressed toward meeting the goals that have been established for us by the President and by the Nation's Governors.

I believe that we have made the changes that will make that possible. We have, as you indicated originally, a new committee under FCCSET chaired by Secretary James Watkins, with Vice Chairmen Ted Sanders of the Department of Education and Luther Williams of the National Science Foundation. That group is already in action.

We have also carried out what I think have been a very effective series of discussions with those two agencies. These have estab-

lished a new level of cooperation between the Department of Education and the National Science Foundation.

Finally, Madam Chairman, let me simply note that through the creation of the President's Council of Advisors on Science and Technology we now have a dedicated private sector group that is committed to working with us to make sure that we have input from the private sector as we do all the other things that we will plan within the Federal Government.

The PCAST effort will be chaired by Peter Likins, who is the president of Lehigh University. Charles Drake, a very distinguished geophysicist from Dartmouth College, will be working closely with them. They will play a leadership role in advising the President and OSTP in these areas.

Let me then stop, Madam Chair, and respond to any questions that you may have.

Senator MIKULSKI. Thank you very much, Dr. Bromley.

We are going to be coming back to you. I ask the panelists to summarize their testimony so that we can get into the questions and colloquy among us.

[The statement follows:]

STATEMENT OF DR. D. ALLAN BROMLEY

SUMMARY

This report responds to language in the Senate Appropriations Committee report on the FY 1990 appropriation for the Office of Science and Technology Policy (OSTP) (Senate Report 101-128). The Committee expressed concern about the level of coordination between the Department of Education (DoEd) and the National Science Foundation (NSF) to improve mathematics, science, and engineering education and requested that the OSTP "take immediate steps to improve any and all coordination problems between the two agencies...." This report describes the progress that has been made in improving coordination between the Department of Education and the National Science Foundation on programs relating to mathematics, science, and engineering education. The report also describes actions of the Director of OSTP to coordinate efforts of all Federal agencies which have substantial interests in mathematics, science, and engineering education.

To achieve the national goal for mathematics and science education, a strategy for (1) improving coordination in mathematics, science, and engineering education between DoEd and NSF in the immediate future, and (2) developing a coherent Federal effort in mathematics, science, and engineering education in the longer term, is being developed.

- A high level, visible formal coordinating mechanism has been agreed on and is being implemented between the DoEd and the NSF to deal with immediate issues and problems.

- OSTP is establishing a Federal coordinating committee to coordinate activities of all Federal agencies in mathematics and science education.

Introduction

Federal, national, State, and local efforts to reform mathematics and science education are coalescing to support the national goal for American students to be first among industrialized nations in mathematics and science achievement. This goal was articulated by the President in the State of the Union Message and by the Governors in their meetings this week in Washington. The Office of Science and Technology Policy (OSTP) is working directly with the leadership of the Department of Education (DoEd) and the National Science Foundation (NSF) to strengthen the efforts of both agencies to meet this goal. The DoEd and NSF have key leadership roles and significant budgets to lead the Federal effort in supporting the States and the localities as they exercise their responsibilities for education reform and improvement.

The OSTP, DoEd, and NSF agree that improved coordination between DoEd and NSF is desirable. Indeed, improved cooperation and coordination is essential to improving mathematics and science education. The latter two agencies have agreed to a strategic planning effort with a clear focus on student learning. Action resulting from that joint planning will assist States, local school districts, schools, and postsecondary education institutions to address major issues and to reform essential education system components related to achievement in mathematics, science, and engineering.

Coordinating the work of DoEd and NSF is an important first step in increasing the overall effectiveness and productivity of the Federal effort in improving mathematics, science, and engineering education in the nation. The magnitude of educational reform in the scientific and technical fields and the length of time needed for successful reform necessitate excellent coordination and collaboration among ALL Federal agencies with interests in science and technology. To that end, the Director of OSTP, as Chairman of the newly

revitalized Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), is taking action to create a FCCSET Committee to deal with human resources and education. The Committee will address significant national policy issues which cut across agency boundaries and will provide a formal mechanism for interagency policy coordination and exchanges of information regarding education and human resource development for science and technology. The Committee will be organized in time to coordinate the development of 1992 budget submissions by the agencies.

The Short Term: Formal Coordination Between the Department of Education and the National Science Foundation

The Secretary of Education (Lauro F. Cavazos) and the Director of the NSF (Erich Bloch) have established formal mechanisms for coordination of mathematics and science education programs between the two agencies. The Director of NSF appointed his Senior Science Advisor (Luther S. Williams) to chair the coordination effort for NSF. The Assistant Secretary for Educational Research and Improvement (Christopher T. Cross) has been charged with heading the coordination effort for DoEd. Coordination at all appropriate levels between DoEd and NSF is the continuing responsibility of these high-level officials. These new coordination efforts replace present ad hoc coordination arrangements.

The formalization of coordination between DoEd and NSF will enable the agencies to plan strategically for an effective Federal effort in the achievement of the national goal in mathematics and science education. It will be possible for the agencies to develop joint programs which focus limited Federal funds on critical factors for improving mathematics, science, and engineering education. A more immediate action the agencies will undertake is strengthening the ties between existing programs which complement and support each other in the achievement of the national goal. Specifically, the DoEd and NSF have agreed that the following programs and activities will be coordinated initially under this new arrangement:

- distribution of NSF educational materials by the DoEd dissemination networks;
- research and development of educational technologies, teaching and learning strategies, and policy for mathematics and science education;
- programs to enhance national and international assessments of student learning in mathematics and science, studies of international comparisons of precollege mathematics and science education, and international mathematics and science educational achievement indices;
- cooperative support of State systems and urban districts to improve mathematics, science, and engineering education;
- programs for increasing participation and achievement of traditionally underrepresented groups in mathematics, science, and engineering education; and
- undergraduate level mathematics, science, and engineering education, including preparation of teachers and faculty.

Use of DoEd Dissemination Networks to Publicize NSF Projects

It is important that high quality materials and documentation of exemplary practices developed by either NSF, DoEd, or jointly by the two agencies reach State and local education agencies. DoEd has dissemination and distribution networks among schools and States, including the National Diffusion Network, the Regional Education Laboratories, the network of coordinators for the Eisenhower Act Mathematics and Science Education Programs, and the Urban

Superintendents' Network. The precise mechanisms to be used to increase the flow of high quality projects funded by NSF into the DoEd's existing dissemination networks will be developed jointly by DoEd and NSF.

Research and Development of Educational Technologies, Teaching and Learning Strategies, and Policy for Mathematics and Science Education

The NSF, through its educational technology program, and the DoEd, via its National Educational Research and Development Centers and the Fund for the Improvement and Reform of Schools and Teaching (FIRST), are supporting significant efforts designed to provide technologies for hands-on science education experiences and improvement of higher order thinking skills, and novel approaches to mathematics and science learning and instruction. A coordinated research and development strategy will greatly leverage Federal expenditures.

Enhanced National and International Assessments of Student Learning in Mathematics and Science, Studies of International Comparisons of Precollege Mathematics and Science Education, and International Mathematics and Science Educational Achievement Indices

One of the most important post-summit/national education goal activities will be the development of appropriate national and international comparative assessments of student learning in mathematics, science, and related technical education. DoEd and NSF already have a strong track record of collaboration and joint funding in national and international assessments of student achievement. Both the DoEd and the NSF are currently funding mathematics and science education achievement indices and international comparisons of mathematics and science performance.
Under the new coordination arrangements, the DoEd and the NSF will establish mechanisms for increased collaboration in national assessments of student achievement in mathematics and science, possibly including co-funding of specific projects as appropriate. A major activity will be to coordinate the needed research, experimentation, and trials of appropriate performance, portfolio, and related assessments which measure authentic acquisition of knowledge, habits of mind, and skills related to mathematics and science.

Cooperative Support of State Systems and Urban Districts

The DoEd and the NSF will pursue cooperative support of State systems and urban districts to improve mathematics, science, and engineering education. Drawing on the resources of the Precollege Division of the Science and Engineering Education Directorate of NSF, and the Eisenhower Program of the DoEd, explicit strategies will be developed for identification of high priority target uses for the funds made available to States and urban districts through the Eisenhower program and those funds granted to States by NSF to promote systemic change in mathematics and science education. Support for systemic change is also available from the mathematics and science research centers and regional laboratories operated by the DoEd's Office of Educational Research and Improvement, and from the Urban Superintendents' Network.

Underrepresented Groups in Mathematics, Science, and Engineering

The DoEd and the NSF will coordinate their efforts to improve mathematics, science, engineering, and technology education for traditionally underrepresented groups. Under the Comprehensive Regional Centers for Minorities in Science and Engineering of the NSF and the Minority Science and Engineering Programs of DoEd, mechanisms will be established to ensure that collaborative efforts serve to leverage the resources committed by each agency, increase the probability of synergistic cooperation, and minimize program duplication.

Programs to Improve Coordination in Undergraduate Education in Mathematics and Science, Including the Preparation of Teachers

For an increased undergraduate mathematics, science, and engineering education effort, mechanisms will be established for co-funding of projects by the DoEd Fund for the Improvement of Postsecondary Education (FIPSE) and the Division of Undergraduate Science, Mathematics, and Engineering Education of NSF. Programs will build on DoEd's and NSF's current work in this area. For example, support for Historically Black Colleges and Universities (HBCU) is a common goal of both DoEd and NSF. Strong coordination will be developed between the DoEd programs supporting research skills among faculty and upper level undergraduate students and the NSF undergraduate programs.

Study of Possible Impediments to Coordination

Both DoEd and NSF operate their programs under legislation that presumes that each has a primary responsibility for mathematics and science education. Both agencies agree that this can result in operating problems, problems working with the States, and even very real perceptions, at some levels, of actual barriers to coordinating and integrating programs. Both agencies agree that a major aspect of their renewed commitment to cooperation will be the joint review of legislation and program regulations to identify specific problem areas and to propose solutions.

The Long Term: Federal Coordinating Council on Science, Engineering, and Technology

The specific activities the DoEd and NSF will coordinate in the immediate future, described above, should be understood in the context of the larger effort to coordinate activities across the government. Recognizing the need for coordination among all Federal agencies with mathematics and science education programs, the Director of OSTP, as Chairman of the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), is taking steps to create a FCCSET Committee to deal with human resources and education. The Committee will be organized in time to coordinate the development of the 1992 budget submissions by the agencies.

This FCCSET Committee will include senior policy-level officials from DoEd and NSF, as well as from other Federal agencies with programs related to education and human resource development in science and technology. The Committee's work will promote more efficient use of expertise in the agencies, reduce program overlap, identify areas of program need, and make more efficient use of limited Federal resources. The objective of this new FCCSET Committee is to develop a truly integrated inter-agency effort in:

- strengthening mathematics, science, engineering, and technology education at all levels; and
- developing and maintaining a technologically and scientifically literate workforce to keep the nation competitive in global markets.

The new and revitalized FCCSET structure will benefit from the work of the President's Council of Advisors on Science and Technology (PCAST). The purpose of PCAST and its ad hoc panels of private sector executives, researchers, and academics is to advise the President on matters involving science and technology. The President's Science Advisor, as Chairman of both PCAST and FCCSET, will ensure that the FCCSET Committee receives the advice and recommendations of experts outside of government. Because education and human resources are issues that necessitate both public and private sector action, and cut across Federal, State, and local boundaries, the issues will be most effectively addressed by the FCCSET when it has access to the best private sector advice available.

Madam Chairman:

I am pleased to be here today to discuss the issue of science and mathematics education. This subcommittee is to be commended for its interest in addressing the science and mathematics education challenge facing this country. Because education and human resources is an issue that involves Federal, State, and local governments and other entities in the public and private sectors, all of us have to work together to meet this challenge and solve the problems we face.

The problems this nation faces in science and mathematics education are well documented. The state of science and mathematics learning among our children, youth, and college-age adults is a serious concern.

Let me briefly touch upon four factors that affect the science and engineering pipeline:

1. There are over 2.5 million fewer college-age individuals in the United States now than there were 10 years ago, and the numbers of 18- to 21-year-olds will continue to drop well into the 1990s.

2. Women and minorities have traditionally been poorly represented in science and engineering, yet these groups make up a larger and larger fraction of young people today. Between now and the year 2000, according to the Bureau of Labor Statistics, 65 to 70 percent of the new entrants into the labor force will be women and minorities, although there will still be a net gain of 2.2 million white males in the labor force.

3. Increasing proportions of experienced scientists and engineers are reaching retirement age. For all Ph.D.'s in the natural sciences and engineering, 15 percent of those employed in 1980 retired in the 1980s. However, 20 percent of those employed in 1990 will retire in the 1990s, and 26 percent of those employed in the year 2000 will retire in the first decade of the next century.

4. To cap it off, the interest of freshmen in majoring in science or engineering has been dropping, in some cases precipitously. Interest in majoring in science and engineering generally has declined by one third over the last two decades. Interest in majoring in engineering is down one quarter since 1982. Interest in majoring in computer science has fallen by more than two-thirds in four years.

I will consider briefly two categories of people, each with its own characteristics and needs. The first category consists of professionals in science and technology, the people who will add to the store of knowledge on which our modern economy is built. The second is the general public, from which the members of the first category come and which has a substantial, though often indirect, effect on the practice of science and technology in this country. In a democracy such as ours, it is essential that our citizens be able to understand the broad issues that affect them, even though they may lack the background and training to participate in the resolution of those issues. Lacking such understanding, many become alienated from their society, and this we simply cannot afford. Literacy--both verbal and numeric--is the foundation on which we necessarily build our future.

Professionals in Science and Technology

Three factors combine to determine the productive capacity of a nation: the numbers and skills of its workers, the level and extent of its technology, and the supply and quality of its capital. I will be focusing my remarks on the first of these factors--the numbers and skills of workers--but it is interesting to note how the first factor influences the other two. In particular, the skills of a nation's scientists and

engineers dictate the level of a nation's technology. In that sense, the capacities of a nation's workforce, from the most skilled to the least skilled workers, are the foundation on which our economic prosperity is built.

During the 1980s, the technical workforce in this country expanded in a very dramatic fashion. The number of people employed as scientists and engineers in private industry increased at a rate almost twice that for all workers. According to statistics gathered by the National Science Foundation, over 5 million people are employed as scientists and engineers in the United States.

I do not believe it coincidental that this dramatic expansion of the scientific and technical workforce has coincided with the longest peacetime economic expansion in this country's history. The link between science, technology, and economic growth has been demonstrated repeatedly in the United States and is now being confirmed in countries throughout the world.

For almost this entire century, better technology has been the answer of the United States to cheap labor abroad and to foreign competition generally. It remains our most important weapon in today's enormously competitive marketplace. We must foster the development of technology at a level commensurate with the rewards that it can bring in terms of economic competitiveness, national security, and an improved quality of life for all our citizenry.

The growth in the number of scientists and engineers in this country will continue into the 1990s and beyond, though probably not at the rapid pace of the 1980s. The National Science Foundation predicts that we will need a third again as many scientists and engineers in the 1990s -- so well over a million additional jobs in science and engineering.

Foreign Students

One way in which the United States has been able to meet the greatly increased demand for scientists and engineers is by relying on foreign students. This is particularly true at the graduate level. About a quarter of the full-time graduate students in science and engineering at doctorate-granting institutions in this country are foreign students, and the proportions are much higher in certain specialties. Every year since 1981, for example, foreign students have earned nearly half of the doctorate degrees granted in engineering in the United States.

Many foreign students report that they plan to remain in the United States following the receipt of their degrees, and it is a good thing for us that they do. Without the very large fraction of foreign students who remain in this country, we would already be suffering from serious shortages of scientists and engineers. We depend on these individuals for a substantial portion of our scientific, technological, and economic strength.

The presence of so many foreign-born scientists and engineers is a great advantage to us. But we should remember that, particularly because so many of these students come from the Third World, their presence here in the United States is regarded by their countries as a brain drain that they can ill afford. This recognition is growing rapidly and will eventually make it increasingly difficult to rely on foreign students.

There is another reason why I believe that we must not become overly dependent on foreign students to supply our future personnel needs. As the infrastructures of other countries develop, foreign students are going to have more incentives to stay in their own countries or return to them once their educations are finished. We cannot continue to assume that foreign students will choose overwhelmingly to remain in this country.

The large fraction of foreign students in science and engineering programs emphatically does not mean that there are too many foreign students in this country.

Rather, it means that too few American students are choosing to enter these fields. Thus, if we are to build up the portion of American students in science and engineering, we must concentrate on the educational system that produces those students.

Women and Minorities

One necessity in building up our own educational system is that we begin to attract and retain many more women and minorities in science and engineering. We are wasting talent for which the nation has urgent need. We trail almost all other developed nations in the participation of women in science and engineering, and the fraction of minorities in the physical sciences and engineering is so small that it is frequently statistically insignificant. For example, in 1988 fewer than 100 Blacks in the United States earned Ph.D.'s in either the natural sciences or engineering.

Yet women and minorities are the groups to which we must turn for an increasing number of our scientists and engineers. Currently, Black and Hispanic youngsters are 25 percent of the school population; by the year 2000 they will be almost half. Traditionally, the largest source of scientists and engineers has been the pool of white males, but the relative size of this pool is shrinking.

You might know that in December the Task Force on Women, Minorities, and the Handicapped in Science and Technology released its final report, Changing America: The New Face of Science and Engineering. That report contains a number of goals for the nation and recommendations for the key players in American society that could increase the representation of women, minorities, and the handicapped in science and engineering. The Office of Science and Technology Policy convened the first meeting of the task force and endorsed its goals. I commend the report to you as an excellent source of ideas about how the problem of scientific and engineering personnel might be addressed.

One surprising aspect of this issue is the dramatic changes that would occur if we can get the pipeline running. As Walter Massey pointed out in a speech to the American Academy of Arts and Sciences last year, if every department in the United States that grants Ph.D.'s made a commitment to double (+1) the number of minority graduates obtaining Ph.D.'s in their disciplines over the next 6 years, dramatic increases in the numbers of Blacks and Hispanics in scientific fields would occur. But he had to add the +1 because many schools do not now grant any Ph.D.'s to minorities.

Precollege Education

I have been discussing a number of problems involving trained personnel, but I am convinced that the heart of the problem remains in the secondary schools and even earlier in the nation's elementary schools. We cannot realistically expect much improvement until we can make substantial changes at these levels.

In 1983, the National Commission on Excellence in Education, in its report A Nation at Risk, warned of a "rising tide of mediocrity" that threatened to engulf our elementary and secondary schools. Yet in the seven years since then, despite a wave of school reform, standardized tests show very little improvement in student achievement.

Many students are lost to science and engineering at an early age. Scientists and engineers tend to decide upon their future careers much earlier than is the case for other professions. So to increase the supply of scientists and engineers, we need to focus on the earliest grades, particularly the elementary level.

If you think about your own experiences or those of your children, one of the primary sources of the problem becomes obvious. In the very first grades, science and mathematics are among students' favorite classes. But by high school, these

classes are among their least favorite. Somewhere along the way we are losing our students to science and technology, not only as professionals but as people who are interested and conversant in the science and technology that pervade our society.

National Education Goals

The President and this Administration are fully aware of the problems we face in this area and have made significant strides in addressing this issue. As you know, the Education Summit held by the President and the nation's Governors led to a set of National Education Goals and objectives to be reached by the year 2000. Science and mathematics learning are central to those goals, which include the following:

> By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter including English, mathematics, science, history and geography [emphasis added]; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy; and
>
> By the year 2000, U.S. students will be first in the world in science and mathematics achievement.

These goals form a national framework for Federal policy and strategic investments in science, mathematics, technological, and engineering education at all levels. However, to achieve these goals, it will be necessary for all concerned parties to work together. Our teachers, students, industry, academia, State and local governments, and the Federal government -- Congress and the Executive Branch -- all have important and varied roles to play.

Federal Initiatives in Science and Mathematics Education

Through the FY 1991 budget, the President has placed high priority on programs and funding for science and mathematics education. The FY 1991 budget proposes over $1 billion in direct spending in five agencies for science, mathematics, and engineering education, an increase of 26 percent above FY 1990. These programs are designed to advance general scientific literacy and mathematics numeracy and to prepare the next generation of scientists, engineers, and technicians.

The National Science Foundation (NSF) and the Department of Education (ED) have substantial programmatic responsibility for science, mathematics, and engineering education, with critical supplementary roles played by the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), the National Institutes of Health (NIH), and the Department of Defense (DOD). Other agencies play important supporting roles as well.

The National Science Foundation's activities are based on the view that the educational process must stimulate the interest of all students so as to ensure that the Nation will have both the scientists and engineers it needs for the future and the technically literate workforce we need as we enter the 21st century. In FY 1991, NSF proposes to invest $463 million in programs that support science and engineering education and human resources. This represents an increase of 30 percent over FY 1990 and includes activities ranging from the precollege level to the undergraduate and graduate level along with a specific focus on programs designed to attract women, minorities, and the disabled to science and engineering at each level of the educational continuum.

NSF has supported a number of programs over the last few years to support its educational objectives. For example, NSF administers a program that provides Presidential recognition of our very best mathematics and science teachers to enhance the status of the profession. NSF has also refocused its training and retraining efforts to reach greater numbers of teachers. NSF has established teacher support networks to improve teacher interaction with practicing scientists and engineers. The Foundation has stressed the creation of private sector partnerships between scientists and engineers, colleges and universities, and other research institutions with local teachers and schools. The Foundation also supports the use of innovative advanced technologies and materials within elementary and secondary schools. In addition, NSF has been successful in efforts to involve the publishing industry by getting them to contribute resources and work with schools, school districts, and academic curriculum development teams all across the nation. NSF also has put in place programs that focus on stimulating and reinforcing the interest of high school students in science and mathematics.

In the FY 1991 budget, NSF has proposed two new important programs. The first is the NSF Statewide Systemic Initiative in science, mathematics, and engineering education. With this effort, NSF will work with the States to plan, design, and take comprehensive actions that only the States can initiate to bring about major educational change. These efforts will make use of the education improvement efforts that are beginning to come from many of the NSF-supported teacher training and curriculum development projects. The applicants for this initiative are being encouraged to describe how they will use Department of Education categorical programs, such as the Eisenhower Act, Chapters 1 and 2 of the Elementary and Secondary Education Act, and vocational education funds, to enhance their proposed efforts. Most importantly, the States Initiative is designed to produce the systemic, comprehensive changes necessary for major improvement of the teaching and learning of science and mathematics at all educational levels (i.e., K-12 and college) by involving teachers, the business community, State and local education entities, and other important individuals and institutions.

NSF also has a significant effort to support improvements in undergraduate and graduate science and engineering education. Many of these activities are closely linked to the research programs. This provides a close and necessary coupling of education and research.

The Department of Education is responsible for programs of teacher training, research and improvement, dissemination and technical assistance, and targeted efforts for the disadvantaged and special student populations. The Department's programs reach every State and nearly every school district throughout the nation. The Department provides support for science and mathematics education through national, merit-based competitive research and improvement grants, formula grants to State and local education agencies, and competitive grants to postsecondary institutions to improve undergraduate programs. In addition, the Department's graduate fellowships in areas of national need are all devoted to the natural sciences and engineering.

A substantial portion of the President's education initiatives are focused on Department of Education efforts to improve the general condition of science and mathematics education and to increase the pool of talent in the fields of science, mathematics, and technology. The proposed National Science Scholars program would provide support for undergraduates who are pursuing science, mathematics, and engineering degrees. Many schools supported under the proposed Magnet Schools of Excellence program are expected to adopt science, mathematics, or technological themes. And the proposed Alternative Certification program is designed to help States attract experienced professionals -- many from the fields of science, mathematics, and engineering -- into teaching.

The Department of Education's FY 1991 budget calls for substantial increases in funding for programs directly focused on science and mathematics education. The 1991 budget proposes $230 million, an increase of $94 million or 70 percent over FY 1990, for the Dwight D. Eisenhower Act mathematics and science education program. These funds primarily support formula grants to States and local school districts for professional development and leadership training, and for competitive grants to colleges and universities that promote school-college partnerships to leverage innovation at the elementary and secondary school levels. In addition, the budget requests nearly $5 billion for Chapter 1 Basic and Concentration Grant funding for education of the disadvantaged, a substantial portion of which will be used by local school districts for remedial mathematics education.

The Department of Education also supports R&D, dissemination of information on exemplary practices, and technical assistance on science and mathematics education. The Department's Office of Educational Research and Improvement (OERI) supports research and indicator studies on science and mathematics in ten of its research centers -- three of which are entirely devoted to science, mathematics, and technology -- and through longitudinal studies and the National Assessment of Educational Progress funded by the National Center for Education Statistics. Information on exemplary practices is disseminated to the field through the National Diffusion Network, information clearinghouses, and regional laboratories funded by OERI; and through the Eisenhower Act State directors network and technical assistance centers funded by the Office of Elementary and Secondary Education.

The Department of Energy's 1991 budget proposes $25 million for science, mathematics, and engineering education through its Office of Energy Research. DOE programs include science and mathematics research exposure for middle and high school students, research training of undergraduates, and graduate fellowships in science and engineering. The DOE supports over 6,000 undergraduates, graduate students, and college and university faculty through research fellowships.

At the National Aeronautics and Space Administration, $50 million, or an increase of 21 percent over FY 1990, is requested to support educational outreach programs for grade school through graduate school. This includes educational programs targeted at elementary and secondary students, elementary and secondary teachers, students and faculty at colleges and universities, the adult general public (particularly parents of pre-college students), and underrepresented minorities in science and engineering education.

The National Institutes of Health provide $292 million in training grants for almost 12,000 graduate trainees in research laboratories. That is over and above the thousands of graduate and post-graduate research opportunities offered students through NIH research grants. In addition, NIH provides biomedical/life sciences training opportunities for undergraduate and high school students through its extramural and intramural programs. Several of these programs focus on attracting minority students into the life sciences, such as the Minority Access to Research Careers program, known as MARC. The MARC undergraduate program includes student and faculty fellowships, and research training for minority students. The President's FY 1991 budget proposal has provided an overall 17 percent increase for MARC and other minority programs.

The Department of Defense typically spends approximately $350 million annually on science and engineering education activities. This includes support for 9,000 graduate research assistantships and fellowships, 13,000 undergraduate scholarships to ROTC students pursuing science and engineering majors, pre-college programs that reach 20,000 students, a variety of programs that provide students and teachers with research experiences in DOD laboratories, and employee training programs that provide undergraduate and graduate education in science and engineering disciplines.

Coordination of Federal Science and Mathematics Initiatives

The department and agency programs described above represent, collectively, some of the Administration's initial efforts to assist States and local communities in achieving the National Education Goals developed by the President and the Governors. The effects of these programs will be limited, however, unless they are closely coordinated across agency lines and unless they work in concert with reforms in the States, local school districts, and schools, colleges, and universities.

I am committed to developing and maintaining a well-coordinated interagency Federal program in support of science, mathematics, engineering, and technology education to achieve the goals. I plan to achieve this coordination through the new Committee on Education and Human Resources within the Federal Coordinating Council on Science, Engineering and Technology (FCCSET).

OSTP is directed in P.L. 94-282 to coordinate Federal science and technology activities and to resolve science and technology policy issues that affect more than one Federal agency. The primary mechanism for this is the FCCSET, which I chair, and which I am in the process of restructuring and revitalizing. FCCSET is the interagency group within the Executive Office of the President that is charged with reviewing, integrating, and coordinating the science, engineering, and technology activities of the Federal government that cut across the missions of more than one Federal agency. As such, FCCSET has the potential to play a substantial role in shaping Federal science, engineering, and technology efforts and recommending alternative budget options.

There have been three meetings of the newly reorganized and revitalized FCCSET, and at each meeting we had excellent representation from the agencies, with Cabinet Secretaries and heads of independent agencies constituting the majority of those in attendance. In general, we foresee a substantially altered and enhanced role for FCCSET within the Executive Branch. For the first time since it was created, FCCSET should be functioning as it was designed to function.

Much of the impetus for FCCSET's revitalization has come from the recent success that several FCCSET committees have had in coordinating cross-cutting areas of science and technology. For example, the Committee on Earth Sciences has taken all of the formerly disparate research being done by Federal agencies on the global environment and has organized it into the U.S. Global Change Research Program -- a coherent, government-wide approach to the scientific understanding of global change. Over the past year the Committee on Earth Sciences has developed a focused, coordinated, multi-agency program of research on global change. This is the kind of coordination I expect FCCSET committees to bring to other important areas of science and technology.

FCCSET has recently formed seven new umbrella committees, each chaired by a high-level official of a Federal agency or department, to oversee broad areas of science and technology. Subcommittees and working groups will be active within each of these umbrella committees to examine, coordinate, and integrate Federal activities in selected areas of science and technology. The seven umbrella committees are in (1) earth and environmental sciences; (2) education and human resources; (3) food, agriculture, and forest research; (4) international science, engineering, and technology; (5) life sciences and health; (6) physical, mathematical, and engineering sciences; and (7) technology and industry.

I expect FCCSET to be a powerful influence in helping to shape and implement Federal science and technology policy. The planning and coordination provided by FCCSET will allow for more effective use of the scientific and technological resources of Federal agencies. FCCSET will work closely with the Office of Management and Budget in developing and reviewing annual and long-range Federal budget plans in selected cross-cutting areas of science and technology.

Policy matters internal to science and technology will be resolved within FCCSET. Policy input involving science and technology to broader issues with strong political and economic components will be channeled to the Domestic Policy Council or the Economic Policy Council for Cabinet-level consideration and eventual presentation to the President.

FCCSET Committee on Education and Human Resources

The new FCCSET Committee on Education and Human Resources is chaired by Secretary of Energy James Watkins, with the Under Secretary of Education, Ted Sanders, and the Assistant Director for Education and Human Resources of NSF, Luther Williams, serving as vice chairs.

The purpose of this Committee is to address issues critical to the provision of the best possible mathematics, science, and engineering education and technical training to enable this generation of American students to become well-informed, scientifically literate citizens; to ensure the Nation of an adequate, well-trained workforce; and to enable the Nation to retain its world leadership position in science and technology. To accomplish this, the Committee will coordinate, on a continuing basis, activities of the Federal agencies related to science, mathematics, engineering, and technological education, training, and human resource development. The Committee will work in coordination with existing President's Cabinet Council working groups, such as the DPC Working Group on Education chaired by Secretary Cavazos and the new DPC/EPC Working Group on Science and Technology which I chair. The Committee's work will promote more efficient use of the expertise that exists in the agencies, avoid needless duplication, identify areas of new program opportunities, and make more efficient use of limited Federal resources.

The members of the FCCSET Committee on Education and Human Resources will include senior policy-level officials from all Federal agencies with significant responsibilities in the area of science, mathematics, engineering, and technological education, including those with jurisdiction over the education of scientists, mathematicians, and engineers, as well as those with responsibilities for technician training and science literacy for the general public. The Committee will also include those agencies that are major users of scientific and engineering personnel.

The agencies that are potential members of the FCCSET Committee on Education and Human Resources include: the Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Interior, Justice, Labor, and Transportation, Veterans Affairs, the Environmental Protection Agency, NASA, NSF, and the Smithsonian Institution. The Office of Management and Budget, the Office of Science and Technology Policy, and the Office of Policy Development serve as Ex-Officio members. Other Federal agencies may participate as appropriate, upon invitation by the Committee Chairman or the Chairman of FCCSET. The Committee Charter and membership will be completed and approved in a few weeks.

One of the first activities of the FCCSET Committee will be to determine the steps the Federal government should be taking to achieve the President's and Governors' mathematics and science education goals. The FCCSET Committee will provide reviews, analyses, advice, and recommendations on Federal policies and programs concerned with education and human resources development with respect to achievement of the National Education Goals. I expect specific recommendations from that Committee for long-range plans for the overall Federal effort in science, mathematics, engineering, and technology education with respect to the accomplishment of the goals.

A working group of the FCCSET Committee chaired by Dr. Luther Williams has begun this process. This group is currently reviewing Federal research and development and support programs directed at improving education, training, and human resources development in mathematics, science, engineering, and technology

education. Based on the work of this group, the Committee on Education and Human Resources plans to produce a report on mathematics, science, and engineering education to accompany the President's Fiscal Year 1992 and 1993 budgets. The report will comprise integrated, coordinated, comprehensive plans and programs, with supporting rationale, for Federal efforts on this subject.

In preparing this report, the Committee will work with FCCSET and OSTP to assist OMB in reviewing current and proposed funding levels for selected science, engineering, and technology issues affecting more than one agency. Such reviews would be undertaken consistent with general budget preparation guidelines established by OMB and would supplement, rather than supplant, the traditional Executive Branch budget formulation process. Final budget decisions will continue to be made in the context of individual agency requests to OMB and ultimately to the President.

NSF-ED Coordination

As a subset of this more broadly based interagency effort, OSTP has worked closely with NSF and the Department of Education to improve coordination of science, mathematics, and engineering education programs between those two agencies. OSTP's March 1, 1990, report to this Committee on NSF-ED coordination is provided as an attachment.

In that report we noted that the Secretary of Education, Lauro Cavazos, and the Director of the NSF, Erich Bloch, have established formal mechanisms for coordination of science and mathematics education programs between the two agencies. The Director of NSF appointed Luther Williams to chair the coordination effort for NSF. Christopher Cross has been charged with heading the coordination effort for the Department of Education. Coordination at all appropriate levels between NSF and the Education Department is the continuing responsibility of these high-level officials.

Initial results of these coordination efforts have been excellent. For example, the Department of Education has initiated dissemination efforts with the NSF and others, whereby the Department's clearinghouses, regional laboratories, and the National Diffusion Network will provide States and localities with timely knowledge about exemplary materials and practices. In addition, NSF and the Department are discussing a special Upward Bound initiative to provide minority high school students with opportunities similar to those provided by the NSF Regional Career Access Centers. Another noteworthy example of the enhanced coordination between NSF and the Education Department is the commitment of the Department to promote the availability of its Eisenhower Act mathematics and science funds for use in conjunction with the recently announced NSF-sponsored Statewide Systemic Initiative.

PCAST

One problem with FCCSET in the past has been that it has had very little input from the private sector. In the future, much greater input will come from the President's Council of Advisors on Science and Technology, a new, high-level advisory group of twelve distinguished scientists and engineers from the private sector. The purpose of PCAST and its ad hoc panels of private sector executives, researchers, and academics is to advise the President on matters involving science and technology. PCAST was established by the President in February and reports directly to him. PCAST has held four meetings thus far -- the first at Camp David in February, and the next three in the White House complex in March, April, and May. The President and several of his top advisors participated in all or part of both those meetings and were involved in very candid discussions with the PCAST members.

Much of the work of PCAST will be carried out through panels chaired by PCAST members and with extensive private sector representation. PCAST is presently

creating a panel to study and report on science and mathematics education. During their March meeting, the PCAST members discussed the issue of science and mathematics education in some detail. PCAST members Peter Likins, President of Lehigh University, and Charles Drake, a professor at Dartmouth College, are taking the lead in defining the plan of the PCAST panel's activities in science and mathematics education.

I believe the PCAST panel will make a constructive contribution to the development of a national science education strategy. PCAST will bring distinguished experts from outside government together to recommend specific actions that should be taken.

As Chairman of both PCAST and FCCSET, I will ensure that the Federal Government receives the advice and recommendations of experts outside of government. Because education and human resources are issues that necessitate both public and private sector action, and cut across Federal, State, and local boundaries, the issues will be most effectively addressed by FCCSET when it has access to the best private sector advice available.

Other National Efforts in Science and Mathematics Education

Federal programs -- however thoughtful, well funded and well managed -- cannot alone bring about the kind and level of improvement in science education that the nation so urgently needs. In our system, the Federal government cannot command reform. It can, however, set national directions and priorities, provide some of the key resources and services needed to make nationwide reform possible, and collaborate with those other agencies and organizations, including the nation's scientific societies, that are engaged in significant reform activities.

The American Association for the Advancement of Science (AAAS) provides an example of the latter. In response to A Nation at Risk, the AAAS launched a series of initiatives to mobilize the scientific community on behalf of the reform of science and mathematics education. At the center of these is Project 2061, an effort involving professional associations, altruistic foundations, private industry, NSF and the Department of Education, and several States.

Project 2061 takes a fresh look at science education: what needs to be learned, how that best can be taught, and ultimately how to convert these findings into practical, functioning education programs. In its first report, Science for All Americans, this comprehensive, long-term project set out what all young people need to know and be able to do in science, mathematics, and technology by the time they finish school -- learning goals for the year 2000 and beyond. In order to facilitate the achievement of those goals, teams of teachers, other educators, and scientists in six locations throughout the country are in the process of transforming Science for All Americans into several alternative curriculum prototypes. These new curriculum approaches will be supplemented by recommendations for changing other aspects of the school system to accommodate them. The Federal government itself could not -- and should not -- operate such an undertaking, but its participation has been, and will continue to be, crucial.

Another instance in which Federal cooperation and support has been important relates to the effort of the Mathematical Sciences Education Board (MSEB) of the National Academy of Sciences to help reform mathematics in our elementary and secondary schools. In 1985, the National Research Council created the MSEB to stimulate and coordinate national reform of mathematics education. The MSEB is a unique coalition of national leaders from the mathematical sciences, education, government, parent groups, and the corporate sector. In its first major publication, Everybody Counts: A Report to the Nation on the Future of Mathematics Education, the MSEB sets forth a compelling argument for fundamental mathematics education changes starting in kindergarten.

MSEB's mission is to guide local actions toward national goals. To carry out its mission, the Board: builds consensus on the goals of mathematics education; promotes national standards; establishes structures for facilitating change; develops prototypes of content and instruction; and reports to the nation on the status of mathematics education.

Private Industry

Another key player in any effort to upgrade science and mathematics education must be industry. Industry now employs about two thirds of scientists and engineers, and industry can have a tremendous influence on the numbers of individuals who eventually go into these fields. The U.S. education enterprise and U.S. industry share many common needs and goals. Neither can survive without the other.

Conclusion

In conclusion, I believe that there are serious problems regarding future supplies of scientists and engineers and people equipped to understand the technological world in which we live. But the resolve to deal with these problems exists and has been growing in this country. What we now need are the specific ideas, addressing specific needs, that will bring about constructive changes.

I am particularly looking forward to working with Admiral Watkins as chairman of the FCCSET Committee on Education and Human Resources, with Luther Williams and Ted Sanders as vice-chairs of that Committee, and with Secretary Cavazos and Mr. Bloch. All have demonstrated their strong commitment to improving science, mathematics, and engineering education, and I expect the sum total of their efforts to have a substantial effect on the scientific and technical proficiency of our nation's citizens.

I appreciate the opportunity to appear before the subcommittee today. I would be happy to answer any questions you might have.

33-741 0 - 91 - 2

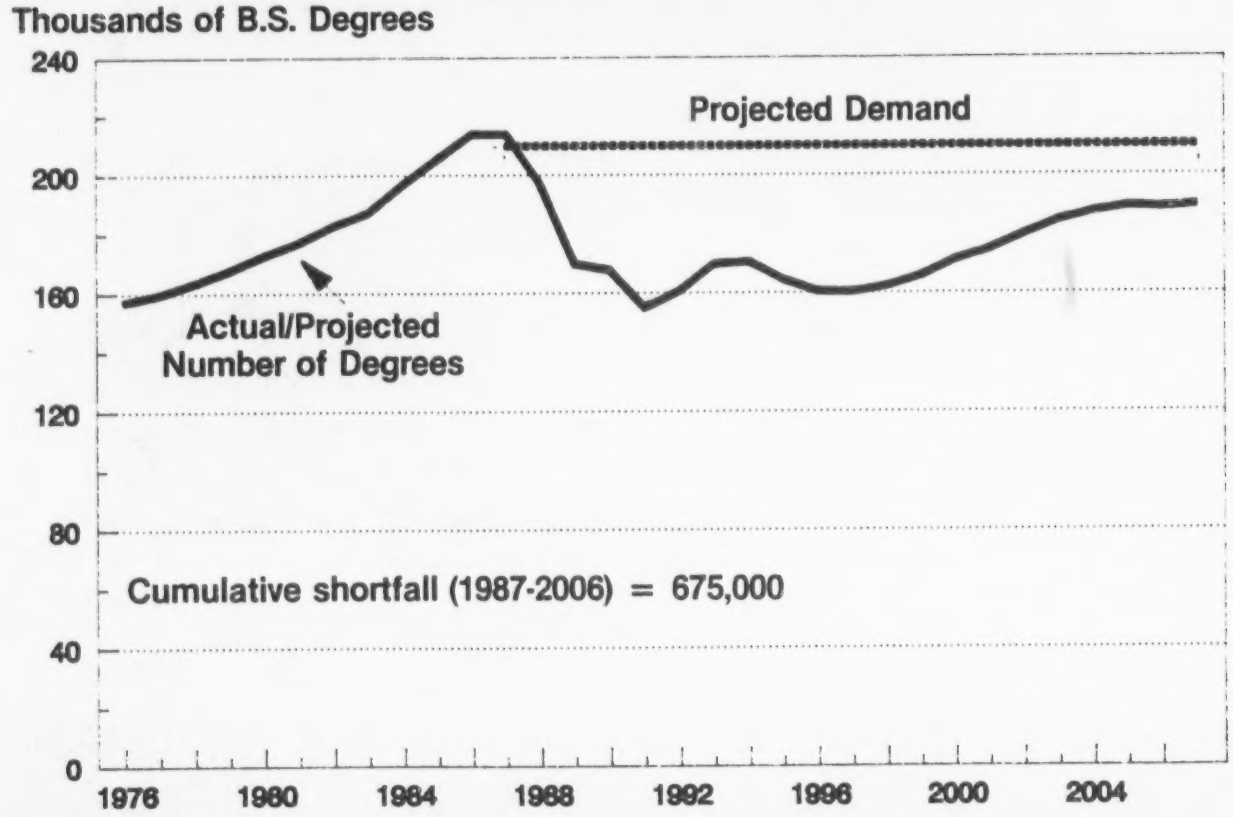
International Comparison of Precollege Education

Nations Ranked by Performance in Category

High School Senior Science Test Scores*	Gross Domestic Product in 1988 Billion U.S. $	Percent of GDP Spent on Precollege Education	Precollege Education Expenditures Billion U.S. $	Per-student Precollege Expenditures U.S. $ per Student
United Kingdom	**United States**	**Sweden**	**United States**	**Sweden**
64	4,818	6.3	163	4,459
Japan	**Japan**	**Japan**	**Japan**	**Canada**
51	1,752	4.8	69	3,717
Australia	**United Kingdom**	**Canada**	**United Kingdom**	**United States**
48	767	4.7	22	3,456
Sweden	**Italy**	**Italy**	**Italy**	**Japan**
44	746	4.1	20	2,844
Canada	**Canada**	**United States**	**Canada**	**Australia**
41	479	4.1	18	2,356
United States	**Australia**	**United Kingdom**	**Australia**	**United Kingdom**
40	222	3.9	7	2,288
Italy	**Sweden**	**Australia**	**Sweden**	**Italy**
36	125	3.7	6.7	1,808

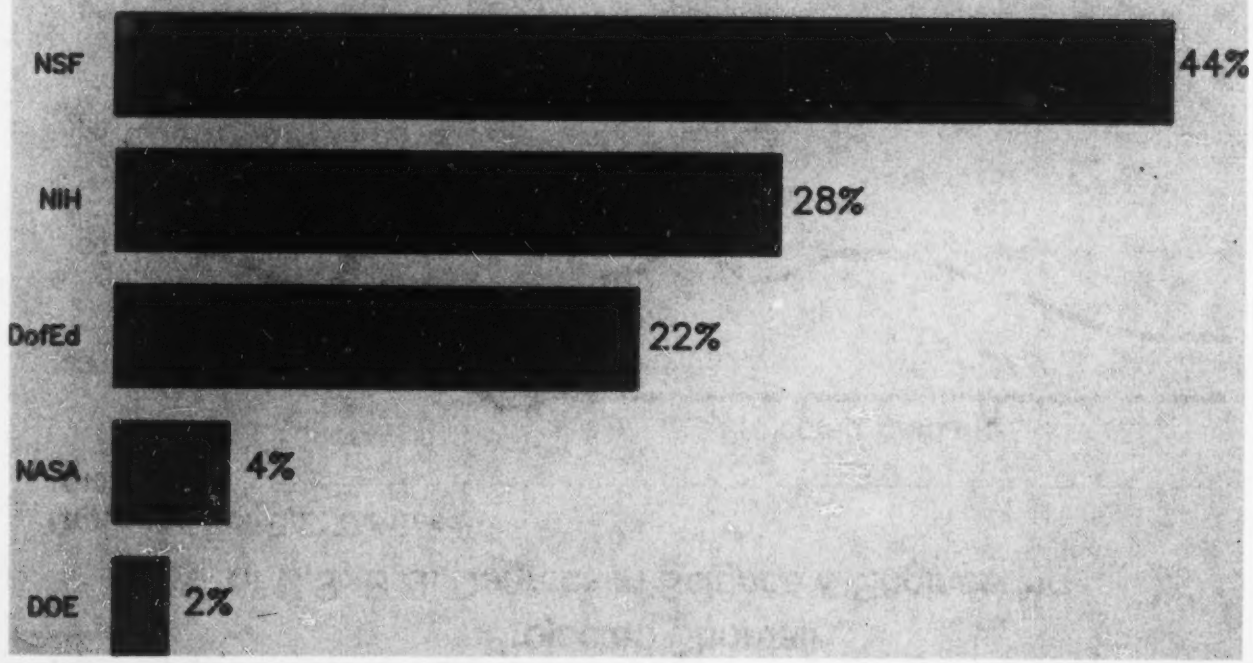
* Average of Scores in AP biology, chemistry, and physics.

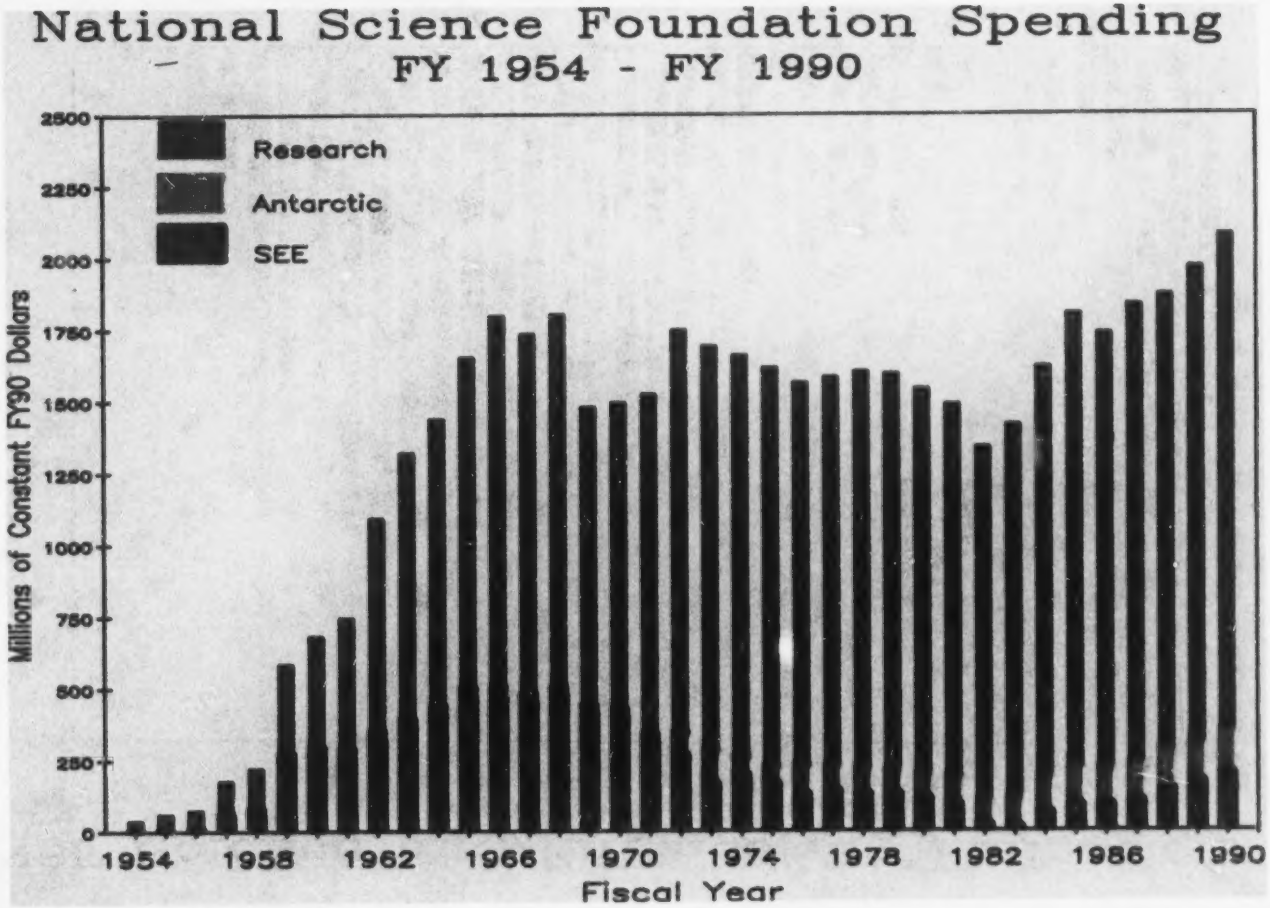
Projected Shortfall
of U.S. B.S. Degrees in Science & Engineering

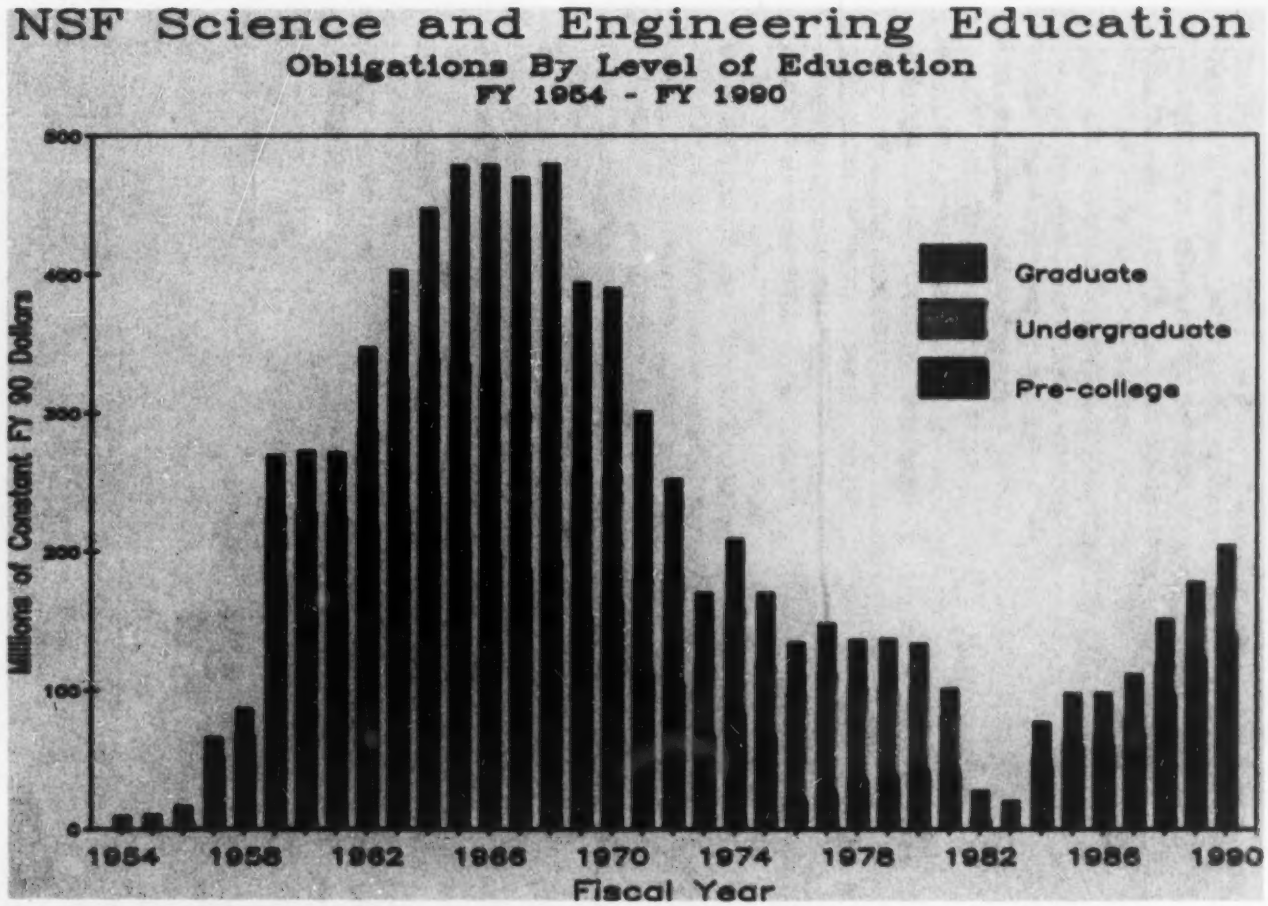


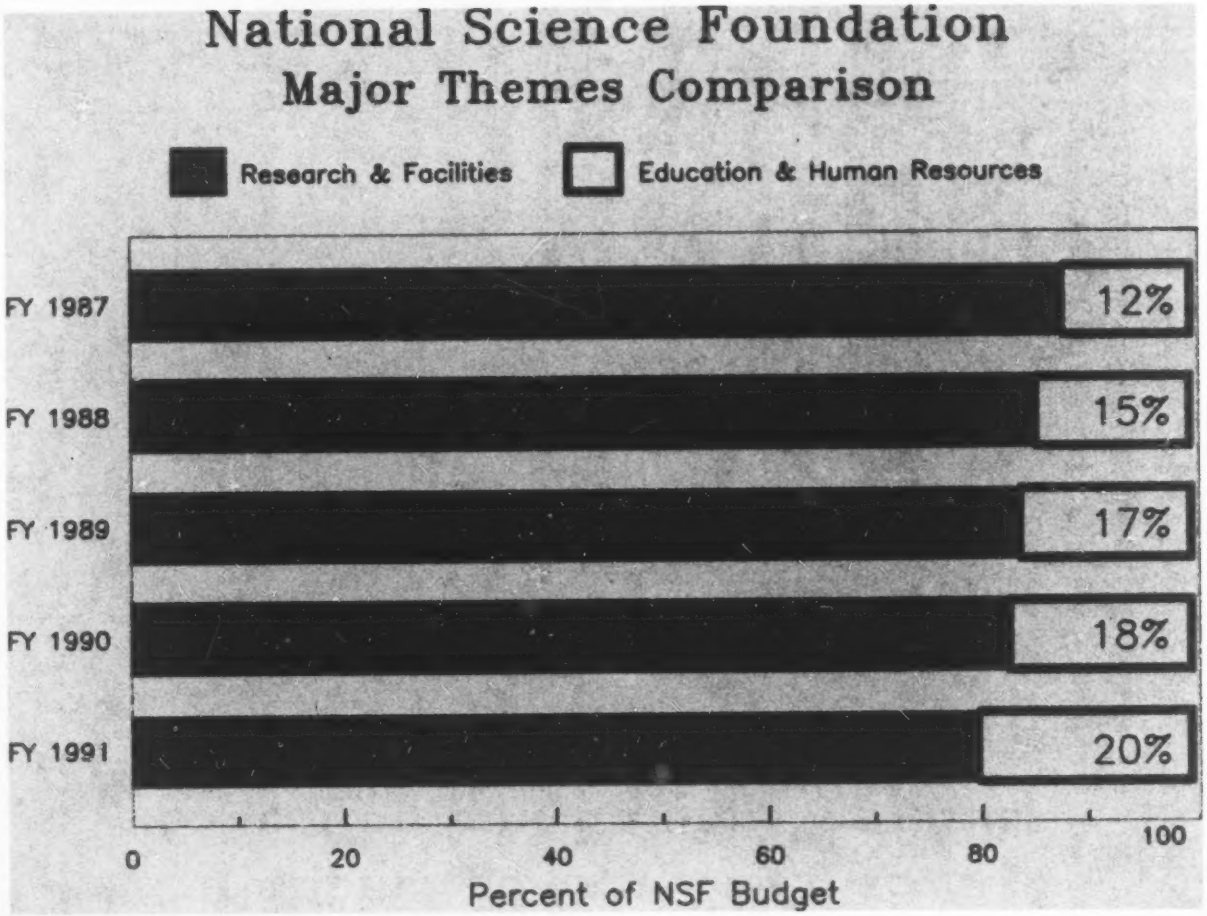
Federal Investment in Science, Mathematics and Engineering Education

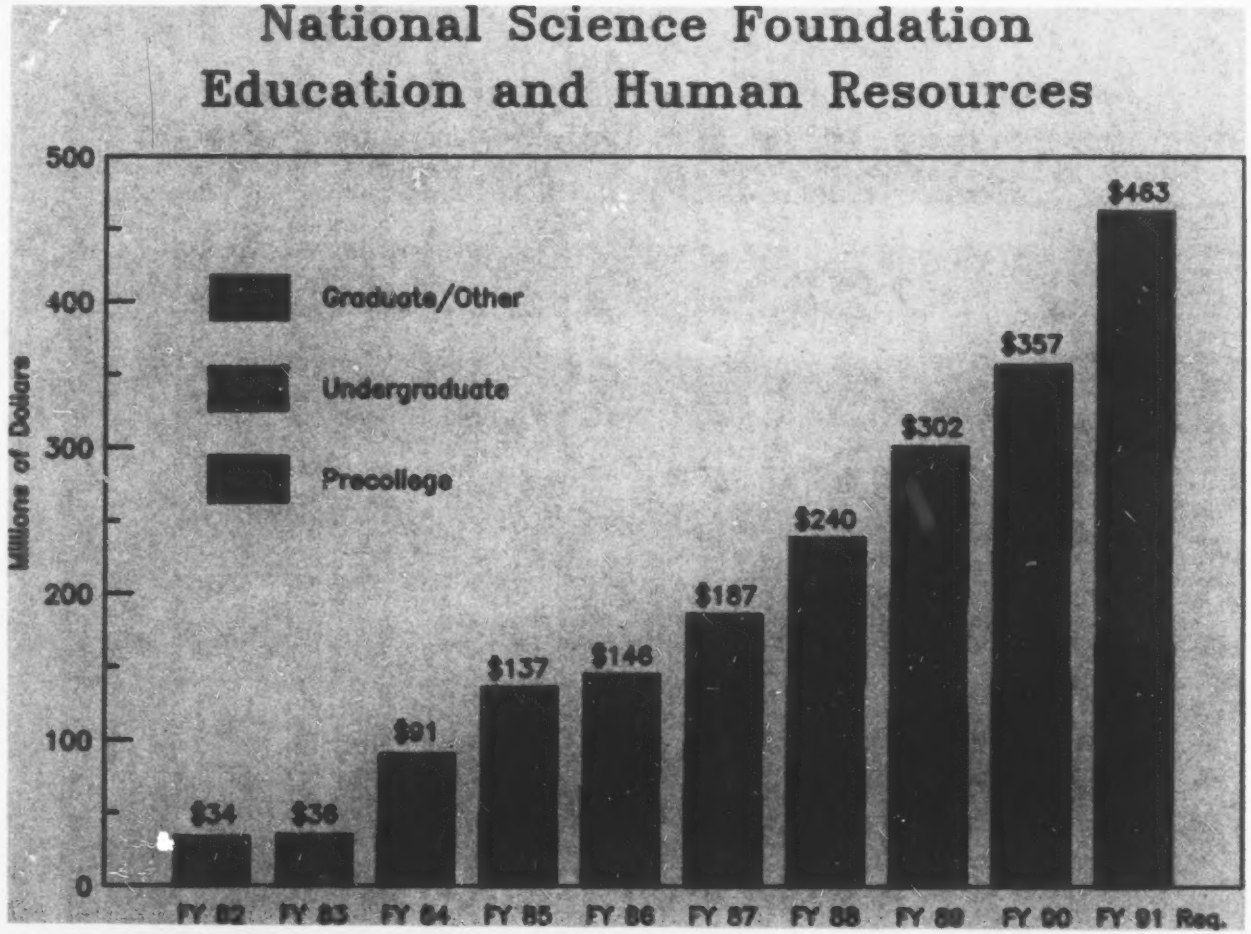
FY 1991 Request

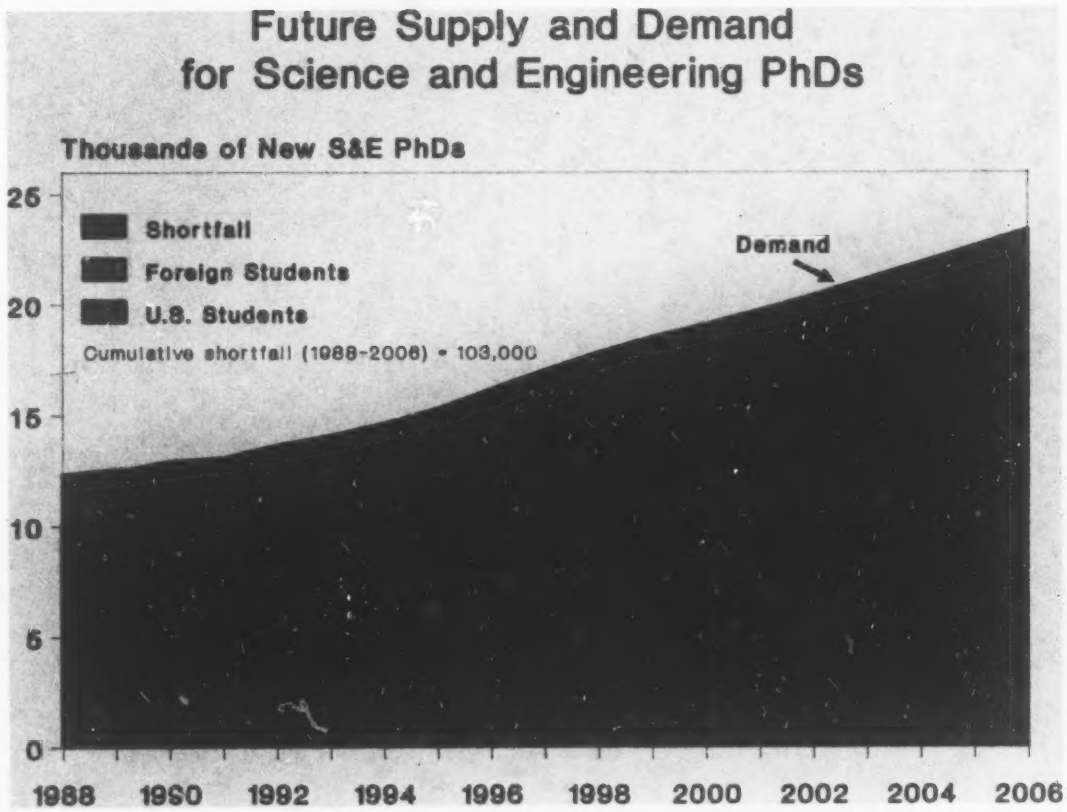



National Science Foundation Spending
FY 1954 - FY 1990
Research
Antarctic
SEE
Millions of Constant FY90 Dollars
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
Fiscal Year


NSF Science and Engineering Education
Obligations By Level of Education
FY 1954 - FY 1990
Millions of Constant FY 90 Dollars
500
400
300
200
100
0
Graduate
Undergraduate
Pre-college
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
Fiscal Year


National Science Foundation
Major Themes Comparison
Research & Facilities
Education & Human Resources
FY 1987
FY 1988
FY 1989
FY 1990
FY 1991
12%
15%
17%
18%
20%
0
20
40
60
80
100
Percent of NSF Budget


National Science Foundation
Education and Human Resources
Millions of Dollars
500
400
300
200
100
0
Graduate/Other
Undergraduate
Precollege
$34
$36
$91
$137
$146
$187
$240
$302
$357
$463
FY 82
FY 83
FY 84
FY 85
FY 86
FY 87
FY 88
FY 89
FY 90
FY 91 Req.


Future Supply and Demand
for Science and Engineering PhDs
Thousands of New S&E PhDs
25
20
15
10
5
0
Shortfall
Foreign Students
U.S. Students
Cumulative shortfall (1988-2006) = 103,000
Demand
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

DEPARTMENT OF ENERGY

STATEMENT OF PEGGY DUFOUR, SPECIAL ASSISTANT TO THE SECRETARY, DEPARTMENT OF ENERGY, AND EXECUTIVE SECRETARY, FCCSET COMMITTEE ON EDUCATION AND HUMAN RESOURCES

INTRODUCTION OF WITNESS

Senator MIKULSKI. The committee will now turn to the testimony of Ms. Peggy Dufour, who is the Special Assistant to the Secretary of the Department of Energy. We know that you are representing Admiral Watkins today and we understand why he cannot be present.

I have worked with Admiral Watkins on the AIDS Commission and I know of your role there in really getting to the heart of the problem and in coming up with very sensible solutions to the issues. We hope that his approach in dealing with Energy is to provide new energy in the area of education. We look forward to your testimony and would ask you to extend to Secretary Watkins an invitation to meet informally with the Senators

Ms. DUFOUR. Thank you, Madam Chair. I am sure he would be delighted to do so.

It is a pleasure for me to appear before you today to discuss the Department of Energy's activities to promote and improve science, mathematics, and engineering education, as well as our efforts through the FCCSET Committee on Education and Human Resources to coordinate our work with that of other Federal agencies.

STATEMENT SUMMARY

These efforts are discussed in detail in my written statement, which I would like to submit for the record, and I would like, in the interest of time, to simply summarize the new initiatives that we are undertaking in the Department, as well as our work on the FCCSET education committee.

During the past year, a number of important changes in our education programs have taken place under Admiral Watkins' leadership at DOE, beginning last October with a conference that was held in Berkeley, CA, cochaired by Glenn T. Seaborg, Nobel Laureate and a very innovative science educator himself.

This is the report of the——

Senator MIKULSKI. Ms. Dufour, I am going to ask you to pull the microphone a little bit closer so that we can hear.

CONFERENCE REPORT

Ms. DUFOUR. The report from this conference was submitted to the committee members along with the other new initiatives that the Department is undertaking. It lays out a plan of action for the Department of Energy, as well as some broad areas of the policy

that we have undertaken in concert with the work of the President and the Nation's Governors on the national education goals.

The report's goals are summarized under students, teachers, underrepresented groups, public science literacy, and competitive work force issues, and I would just like to concentrate on three action items under those goals:

We believe that each year 10 percent of the Nation's teachers should be provided with high-quality teacher enhancement programs in hands-on science between now and the year 2000. We also believe that scientists, engineers, and mathematicians should serve as volunteer expert teaching partners to bring cutting edge science into the Nation's classrooms in numbers equaling 10 percent of the total teaching force. Under science alliances, we believe that mathematics and science community alliances, which would include partners from government, education, and business, should be established or significantly expanded in 10 percent of the Nation's schools over the next 24 months. These are the large action items that came out of this conference.

The conference in Berkeley was attended by 250 individuals from all aspects of government, and many of the individuals to be testifying before you today took part or sent representatives. One of those who was very kind to attend was Admiral Truly and his staff. We also had individuals who represented leadership in the education and business communities.

PARTNERSHIPS

A special emphasis that has come out of that conference was placed on partnerships, and I would like to indicate four of those that the Department has undertaken. These are partnerships between the Department's laboratories and the surrounding school districts.

In Chicago, the Science Explorers Program is a collaboration between Argonne and Fermi National Laboratories, the Chicago public schools, and 10 other Chicago institutions involved in science and education. This project has the potential in its first year to reach 10,000 schoolchildren in Chicago.

Another initiative is the cooperative program between Oak Ridge Associated Universities, Oak Ridge National Laboratory, and the Roane County and Chattanooga public schools in Tennessee. This partnership involves pairing teachers and student teams and giving them summer activities, including research appointments and institutes in the laboratory.

A third initiative, in the State of Washington, began this spring and involves Pacific Northwest Laboratory in a collaborative science program that includes the Hispanic, Black, and Native American populations in the Yakima Valley, Seattle, and Portland areas.

And a fourth initiative will involve the Sandia and Los Alamos National Laboratories in the Southwest, in partnership with middle schools and New Mexico's State and Native American schools in northern New Mexico and Arizona.

Again, all of these new initiatives are described in detail in the submitted materials.

On May 18, Secretary Watkins signed an MOU between our Department and NASA, signed by Admiral Truly. And we have also signed one with the Appalachian Regional Commission. We are also working on one with the Departments of Education and Interior. EPA and NOAA have also expressed interest in doing this.

On May 21, Admiral Watkins also issued a Secretary of Energy notice establishing science education as a primary mission of the Department of Energy and encouraging education outreach efforts on the part of all DOE and contract personnel.

INTERAGENCY COOPERATION

Now, on interagency cooperation, Dr. Bromley has testified on the FCCSET initiative of OSTP, and I would like to tell you a little bit about the Committee on Education and Human Resources. We expect this Committee to play a major role in ensuring that agency efforts are closely coordinated in concert with the reforms going on in the States, local districts, and colleges and universities.

The Committee will also promote the more efficient use of the expertise that already exists in the Federal agencies and avoid needless duplication. We hope that it will identify program strengths and weaknesses to make more efficient use of limited Federal resources.

As stated by Dr. Bromley, the objective of this new Committee is to develop a truly integrated interagency effort that will do two things: strengthen science, math, engineering, and technology education at all levels; and develop and maintain a technologically and scientifically literate work force, to keep the Nation competitive in global markets.

Letters of invitation have gone out to agency heads for participation in the Committee. And in addition to Energy, Education, and NSF, the membership will include Agriculture, Commerce, Defense, HHS, HUD, Interior, Justice, Labor, Transportation, Veterans Affairs, EPA, NASA, and the Smithsonian.

OSTP, OMB, and the Office of Policy Development in the White House are ex officio members to help us further coordinate the followup efforts with the education summit as well as with PCAST.

Now, in addition we are also seeking budget and program information from such sources as the Tennessee Valley Authority, the Institute of Museum Services, the Nuclear Regulatory Commission, the Barry Goldwater Scholarship Foundation, and the Appalachian Regional Commission, as they also have moneys in this area.

Also, once constituted, the Committee will begin to work to develop a data base of all the science education programs funded by Federal agencies, which will be a large project.

EDUCATIONAL BASE EXPANDED

In summary, I believe that DOE has taken great strides in the past year to expand its already significant educational base. But I also believe that this could never have happened without the full cooperation and support of the Department of Education, the National Science Foundation, NASA, and others with whom we already enjoy excellent working relationships.

Our principal resource in this new effort will not be dollars alone. Admiral Watkins frequently says that it is not a matter of new money; it is using the resources we already have. It will be the many thousands of DOE scientists, engineers, and other support staff who will be working with teachers and students throughout the country.

DOE is committed to providing sustained long-term support to science and math education improvement and also to working through FCCSET to actually maximize interagency coordination.

This summarizes my statement, Madam Chairman, and I would be happy to answer any questions.

Senator MIKULSKI. Thank you, Ms. Dufour, for really a most comprehensive testimony. We will be coming back to you.

The committee welcomes Senator Grassley, a very faithful participant of this committee.

Senator, we are going to ask you to withhold your opening statement until we get to questions.

[The statement follows:]

STATEMENT OF PEGGY DEFOUR

Madam Chairman and Members of the Subcommittee, it is a pleasure to appear before you today to discuss the Department of Energy's activities to promote and improve science, mathematics and engineering education for the Nation's children and their teachers, as well as our efforts through the Federal Coordinating Council on Science, Engineering and Technology (FCCSET) Committee on Education and Human Resources to coordinate the work of our agency with that of others in the Federal Government. As this Subcommittee is aware, achieving excellence in science and mathematics is one of the Nation's six educational goals, as announced by the President and the Governors. The Department's efforts are being carried out as part of the strategy to help reach that goal.

As this Subcommittee knows, there is a growing consensus that one of the most serious problems facing the Nation over the next ten years is the declining number of young Americans, including women, minorities and the disabled, interested in pursuing careers in science and engineering. Those who are interested often receive inadequate preparation for such careers. This situation represents a crisis in science education that has serious implications for our Nation's continued international economic and technological competitiveness. It also has implications for the Department's ability to carry out its science, energy, and defense research and development missions.

The Department of Energy is both a user and a patron of a large portion of the Nation's scientists and engineers. To meet both current and future challenges, the Department must depend on the scientific and technical skills of its workforce. DOE must also play a major role in ensuring that there will be an adequate number of well-trained, highly motivated young people involved in future DOE and other national research efforts. The Department is uniquely positioned to assist in this work by providing students and their teachers with "hands on" experience in ongoing, cutting-edge scientific and technical research. This important aspect of the Department's mission was reaffirmed

and expanded by the Secretary of Energy Notice issued by Admiral Watkins on May 21, 1990.

UNIVERSITY AND SCIENCE EDUCATION

The historic focus of DOE efforts in science education has been at the graduate and postdoctoral levels, through DOE support of university research. In FY 1990, that level of support was approximately $450 million, which also funded the participation of 3,500 to 4,000 graduate students. In recent years, because of our growing awareness of the need to encourage younger students and keep them in the science pipeline, the Department has also expanded its support of precollege and undergraduate-level science education programs at its major laboratories, including programs that enable students and teachers to experience hands-on participation in cutting-edge research.

CURRENT SCIENCE EDUCATION ACTIVITIES

I would like to summarize for the Subcommittee the Department's current science education programs. These programs focus on:

- Providing opportunities for students and their teachers to improve their scientific and technical skills and knowledge; and

- Utilizing the unique resources of the Department's national laboratories, primarily by providing hands-on research experience, to support and assist in the education of young people for careers in science, mathematics and technology, including those currently underrepresented in those professions.

The seven national laboratories that are currently designated as Laboratory Science Education Centers are Argonne, Brookhaven, Fermi, Lawrence Berkeley, Los Alamos, Oak Ridge and Pacific Northwest. Each center is responsible for the planning and administration of national, regional and State and local science education programs. These centers, along with a number of other DOE

facilities, conduct a range of precollege and university science education programs which vary by laboratory. Descriptions of the programs currently underway at the various DOE laboratories and facilities are attached to my testimony.

I would like to describe in more detail a few examples of the science education programs currently supported by the Department at the national laboratories and other DOE research facilities that are the foundation for our expanded initiatives at the precollege level.

- o <u>High School Science Student Honors Research Program</u>

  This program provides a two-week summer hands-on research opportunity for the very best high school science and mathematics students from each State, Puerto Rico, the District of Columbia and some foreign countries. Students are selected by the Governors in response to an invitation from the Secretary to participate in this national, competitive program. Three hundred seventy four students are currently supported. Approximately 30% are women or minorities. Seven laboratories participate: Argonne National Laboratory (material science including superconductivity), Brookhaven National Laboratory (physics, material science and biology), Fermi National Accelerator Laboratory (high energy particle physics), Lawrence Berkeley Laboratory (life sciences), Lawrence Livermore National Laboratory (computational sciences using the CRAY II supercomputer), Oak Ridge National Laboratory (environmental science), and Pacific Northwest Laboratory (desert and marine ecosystems).

- o <u>High School Teacher Research Associates (TRAC) Program</u>

  Science and mathematics teachers from each State are nominated by the Governors to participate in a special eight-week research program at selected laboratories. About 135-150 teachers (roughly 50% women and <10% minorities) participate in this national, competitive program. They serve as members of research teams and their experience may include preparation of supplemental materials and experiments for use back in the classroom. This program increases teacher awareness and

understanding of current science and technology and promotes transfer of new knowledge to the classroom.

- o High School Student Research Apprenticeship Program

  This program is designed to motivate freshmen and sophomore high school minority and female students to pursue science careers. About 130 students (>90% minorities and women) are involved in a six to eight-week summer experience at a laboratory which includes laboratory research, lectures, seminars and field activities. Four laboratories (Argonne, Brookhaven, Fermi, and Pacific Northwest) will be involved in FY 1990.

- o Partnership Schools Program

  DOE operations offices and laboratories have developed partnerships with local elementary/secondary schools as part of the President's National Partnerships in Education Program. Examples are: DOE Headquarters and Woodrow Wilson Senior High School in Washington, D.C.; Chicago Operations Office and Bolingbrook High School; Nevada Operations Office and Mountain View Elementary School; and Oak Ridge National Laboratory and the science departments at six local high schools. Adopted schools receive DOE assistance in such areas as "loan" of equipment and materials, career counselling and tutoring, field trips to scientific facilities, assistance in science fair projects including judging, etc.

- o Outreach Activities

  Each laboratory conducts a number of both formal and informal programs in addition to those noted above. Components of these programs include research participation; workshops and institutes; supplemental materials; in-house tours, lectures, and demonstrations; direct classroom instruction; community outreach; and a variety of special events. Examples include the Fermi Saturday Morning Physics lecture series for high school students, the Pacific Northwest Laboratory Sharing Science with Schools program for junior and senior

high schools, and the Fermi workshop for junior and middle high school teachers which introduces concepts in particle physics for use in the classroom. In addition, there are a number of "ad hoc" support activities and membership in professional and community organizations. The program goals are to enhance student interest in science careers and scientific literacy in general. The goals for precollege teachers include enhancing content knowledge, improvement of instructional strategies, increased career awareness, understanding of science-technology-society relationships, and enhanced supplemental materials.

Participation in the Department's education programs is not restricted by gender or race. Because many of the Department's major laboratories are located near population centers including rural, urban, minority or economically disadvantaged students, our laboratory-based programs and outreach efforts have the additional benefit of reaching large numbers of students currently underrepresented in science and technology.

In addition to the above laboratory based programs, DOE supports a national pre-college program, the PreFreshman Engineering Program (PREP). PREP provides support primarily for colleges and universities which grant engineering degrees, to conduct summer institutes for junior or senior high school students (7th - 10th grades). This program helps maintain students in the engineering pipeline by preparing and guiding young students in the selection of college-preparatory courses in science and mathematics. The summer activities focus on activities that encourage students, including women and minorities, to consider careers in science-related fields. PREP provides a number of pre-engineering enrichment experiences including laboratory work, field trips, tutoring and counseling. Institutions are encouraged to cost share the projects with university and/or industrial support. This program reaches 1,500 - 2,000 students per year.

Other DOE program offices in addition to the Office of Energy Research are also involved in providing support for science education. The Office of

Environmental Remediation and Waste Management is in the process of developing major new educational initiatives designed to encourage more young people to consider careers in environmental remediation. Much of this work will involve community colleges and four year colleges since the principal manpower needs in environmental remediation will require education and training at the associate and bachelor's degree levels. Other DOE education initiatives include workshops for high school science teachers on the science issues surrounding global climate change. One product of this support is now in field testing at the Lawrence Hall of Science in Berkeley. This is a Macintosh Hypercard Program which includes all the basic "known" facts on global climate change written at the middle school level. The missions of all the DOE technology program offices have been expanded to include support for program-specific science education activities. We expect to include several new science education initiatives from the energy technology programs in future year budget requests.

NEW PRECOLLEGE INITIATIVES

During the past year, a number of important changes in our education programs have taken place under Admiral Watkins' leadership at the Department of Energy. First, Admiral Watkins and Nobel laureate Glenn T. Seaborg co-chaired the Math/Science Education Action Conference at the Lawrence Hall of Science in Berkeley, California last October, just ten days after the President's historic Education Summit with the Nation's Governors. Over 250 scientists, educators, policy makers and industry representatives attended, including representatives from the White House, the National Science Foundation and NASA, as well as the Departments of Education, Interior, Defense, Health and Human Services, and Labor, and the U.S. Congress. One of those who graciously gave of his time to participate was Admiral Truly, Administrator of NASA. Representatives of almost all of the agencies on today's panel were also in attendance.

The Berkeley Conference report was released at a press conference on May 22. Copies of the report have been provided to this Subcommittee. It clearly outlines new directions in science education for the Department, as well as specific actions the Department will undertake to more fully utilize its unique regional scientific resources to support science education. Also presented were the new education partnership initiatives inspired by the Berkeley conference, as examples of the joint efforts underway between DOE and other Federal agencies, and DOE and the private sector.

The Berkeley report lays out a plan of action for the Department, in partnership with other Federal agencies, the various States, schools and private sector organizations. The major goals endorsed by this report are as follows:

1. Students. American elementary and secondary students will receive excellent preparation in mathematics and science in every grade.

   Performance. American students will be the best in the world in their knowledge of mathematics and science.

   Curriculum. The Nation will have in place an integrated, interdisciplinary core curriculum for mathematics and science in pre-school through high school.

2. Teachers. The Nation's mathematics and science teaching professionals will attain their rightful place as full-share partners in the scientific community and will become empowered to prepare this generation of children for lives of discovery in the 21st Century.

   Enrichment. Each year 10% of the Nation's teachers will be provided with high-quality teacher enhancement programs in hands-on science.

   Partners. Scientists, engineers, and mathematicians will serve as volunteer expert education partners to bring cutting-edge science into the Nation's classrooms, in numbers equaling 10% of the teaching force.

3. Underrepresented Groups. Significantly greater numbers of female, minority, disabled or disadvantaged students will complete a K-12 education program, advance to the highest levels of mathematics and science education, enter careers in mathematics and science, and complete teaching programs in these fields.

4. Public Literacy. Citizens will understand and derive excitement from confronting new frontiers in science, mathematics, and technology and will appreciate their potential for bettering our society and our world.

   Science Alliances. Mathematics and science community alliances including partners from government, education, and business, will be established or significantly expanded in 10% of the Nation's school districts over the next 24 months.

5. Competitive Work Force. The Nation will have a diversified work force, competent in mathematics and science and equipped to meet the technological demands of the 21st Century.

The FY 1991 budget in DOE's Office of Energy Research of $29.7 million for University and Science Education reflects, in part, the Secretary's and the Department's commitment to meet the goals of the Berkeley report. The Department will continue the existing base programs that I described earlier as well as undergraduate student summer and semester research programs and faculty and graduate student research activities. The Department will initiate a number of new activities based on the other recommendations from the Berkeley Conference. A description of each of these new initiatives is attached to my testimony. Let me summarize several of them.

Among the new initiatives proposed for FY 1991 will be the establishment of a precollege mathematics science education program at the DOE laboratories. There will also be: a traveling museum-based science education program

consisting of exhibits on major energy-related scientific programs; increased precollege science teacher research appointments and minority high school student appointments to encourage more students to stay in the math/science pipeline; and emphasis on reaching students at a younger age, including women and minorities, through an expanded Prefreshman Engineering Program (to be renamed the Prefreshman Enrichment Program encompassing math, science, and engineering).

Partnership Programs

Special emphasis will be placed in FY 1991 on the development of partnerships between DOE laboratories and inner-city and rural schools. These partnerships will be directed at revitalizing math and science education in the targeted schools. I would like to summarize four of these initiatives that respond to this new emphasis on science education. The Chicago "Science Explorers Program" is a collaboration among Argonne, Fermilab, the Chicago Public Schools, and ten other Chicago institutions involved in science education. The program is aimed at stimulating a high level of interest in science and math in 10,000 Chicago students. Another initiative is a cooperative program in math and science education among the Oak Ridge Associated Universities, the Oak Ridge National Laboratory and the Chattanooga and Roane County Public Schools. This partnership will involve a series of teacher and student-focused activities including summer institutes and research appointments. A third initiative will begin this Spring and will involve the Pacific Northwest Laboratory in a collaborative science education program that includes the Hispanic, Black and Native American populations, in the Yakima Valley, Seattle and Portland areas. A fourth initiative will involve the Sandia and Los Alamos National Laboratories in partnership with middle schools in New Mexico State and Native American schools in Northern New Mexico and Arizona. These and the other new initiatives announced by the Secretary on May 22 are described in more detail in the attachment to my testimony.

Memoranda of Understanding

Most recently, on May 18, 1990, Secretary of Energy James D. Watkins signed two Memoranda of Understanding (MOU's) directed at encouraging more students to pursue careers in science, math and engineering. The first was co-signed by NASA Administrator, Richard Truly, and the second by Jacqueline Phillips, Federal Co-Chairman of the Appalachian Regional Commission. Other agencies with whom we are working to develop additional MOU's include the Departments of Education and Interior, and the Environmental Protection Agency and the National Oceanic and Atmospheric Administration have also expressed interest. In addition, the DOE holds staff-level meetings with the National Science Foundation (NSF), the Department of Education, the Department of Defense (DOD), NASA, Department of Agriculture and several other agencies in order to ensure the effectiveness and efficiency of our science education programs. Partnership is the hallmark of all new activities undertaken by the Department in education.

On May 21, 1990 Admiral Watkins issued a Secretary of Energy Notice, establishing education as a primary mission of the Department, and encouraging education outreach efforts on the part of all DOE and contract personnel.

Copies of the Berkeley conference report, the new initiatives, the MOU's, and the Secretary of Energy Notice have been provided to you, along with a list of the educatjon programs currently in operation at our major research laboratories.

INTERAGENCY COORDINATION

As Dr. Bromley has testified, the Office of Science and Technology Policy is committed to developing and maintaining a well-coordinated interagency Federal program in support of science and mathematics education. Dr. Bromley has asked Admiral Watkins to serve as Chairman of the Federal Coordinating Council on Science and Technology (FCCSET) Committee on Education and Human Resources, with Ted Sanders, Under Secretary of Education, and Luther Williams, Assistant

Director for Education and Human Resources at the National Science Foundation, as Vice-Chairmen. The committee has already begun staff work under the leadership of Dr. Luther Williams on a multi-agency budget cross-cut in science and engineering education.

Under Admiral Watkins' chairmanship, the new FCCSET Committee on Education and Human Resources will coordinate, on a continuing basis, activities of the Federal agencies related to science, mathematics, engineering, and technological education, training, and human resource development. We expect this Committee to play a major role in ensuring that agency efforts are closely coordinated, and act in concert with reforms in the States, local school districts and schools, colleges and universities. The Committee's work will promote more efficient use of the expertise that exists in the agencies, avoid needless duplication, identify program strengths and weaknesses and make more efficient use of limited Federal resources. As stated by Dr. Bromley, the objective of this new FCCSET Committee is to develop a truly integratedinteragency effort in:

- o strengthening science, mathematics, engineering, and technology education at all levels; and
- o developing and maintaining a technologically and scientifically literate workforce to keep the Nation competitive in global markets.

The members of the FCCSET Committee on Education and Human Resources will include senior policy-level officials from all Federal agencies with significant responsibilities in the area of science, mathematics, engineering, and technological education and those agencies that are major users of scientific and engineering personnel. It will be made up of those with jurisdiction over the education of scientists, mathematicians, and engineers, as well as those with responsibilities for improving the science literacy of the general public.

The following additional agencies are expected to be among those that will participate:

Department of Agriculture
Department of Commerce
Department of Defense
Department of Health and Human Services
Department of Housing and Urban Development
Department of Interior
Department of Justice
Department of Labor
Department of Transportation
Department of Veterans Affairs
Environmental Protection Agency
National Aeronautics and Space Administration

The Office of Science and Technology Policy, the Office of Management and Budget, and the Office of Policy Development serve as ex-officio members of the committee. In addition, budget and program information will also be sought from agencies and institutions, such as:

Tennessee Valley Authority
National Commission on Libraries
Institute of Museum Services
Nuclear Regulatory Commission
Barry M. Goldwater Scholarship and Excellence in Education Foundation
Appalachian Regional Commission

Letters of invitation have gone out to agency heads requesting their designees for committee membership. Once constituted, the Committee will finalize its charter and begin work to develop a data base of all the science education programs funded by Federal agencies.

In summary, I believe that the Department of Energy has taken great strides in the past year to expand its already significant educational base, but that this could not have happened without the full cooperation and support of the Department of Education, the National Science Foundation, NASA and others with

whom we enjoy excellent working partnerships. Our principal resource in this effort will not be dollars alone -- it will be the many thousands of DOE scientists, engineers and other support staff who will be working in partnership with teachers and students at all educational levels across the country.

The Department is committed to providing sustained, long-term support to science and math education improvement, and working through the FCCSET Committee on Education and Human Resources to maximize interagency coordination.

That concludes my statement. I would be happy to answer any questions.

NATIONAL SCIENCE FOUNDATION

STATEMENT OF ERICH BLOCH, DIRECTOR

INTRODUCTORY REMARKS

Senator MIKULSKI. We would like to now turn to Mr. Erich Bloch, the Director of the National Science Foundation, one of whose prime missions has been science and math education.

Mr. Bloch, we look forward to your testimony.

Mr. BLOCH. Thank you, Madam Chair. I have a longer prepared statement to submit for the record, but I would like to make a few summary comments.

SUMMARY COMMENTS

But first let me add to Dr. Bromley's remarks and commend you, Madam Chair, for holding this very unprecedented hearing. We are all united by a common concern: our need for science and mathematics education and human resources.

I was very much encouraged by the comments that were made by Senator Garn before, and I have seen his support in what I call the nonspectacular but equally important kind of programs that the National Science Foundation represents in both education and human resources; and also Senator Kerrey's comments—he has always focused on the question of education and on the issues associated with it.

The Nation depends upon a well-educated technical work force to compete in today's global economy and the agencies that are represented here today in particular depend on scientists, engineers, and a technical work force to carry out their missions, be it space, medical research, environmental protection, or, as in the case of NSF, fundamental research and education in math, science, and engineering.

NSF MISSION

The Foundation's mission statement gives us a major role in the education and training of the Nation's technical work force, and two of our highest priorities are recruiting and retaining the technical talent needed to meet our labor force needs in the nineties and beyond and enhancing the science and technology literacy of all of our citizens.

Our overriding goal is to help ensure that by the year 2000 U.S. students will be first in the world in science and mathematics achievement, and to achieve that goal we must take action and provide opportunities for students who have an interest in mathematics and science and engineering or who can acquire an interest in these activities.

Only in this way can we prepare students for employment and citizenship in a world of increasing technological complexity.

STRATEGY

Our strategy is based on the understanding that the educational process is a series of interdependent, interconnected stages, with links from preschool to grade 12 through undergraduate and graduate study. NSF programs are designed to address the specific problems, opportunities, and needs at each critical stage and to strengthen the connecting links.

Our strategy is also based on the realization that the Nation's educational system is complex and decentralized, with responsibilities located at many levels.

Our programs are designed to be catalysts and the projects we support are expected to be models for what can and should be done to improve the quality of the math and science education provided throughout our education system. Given our resources, NSF programs are also designed to leverage these resources from other Federal agencies, the States, and the business communities.

STRATEGIC OBJECTIVES

We have set for ourselves a number of specific strategic objectives, ranging from enhancing the effectiveness of teachers, increasing the number of university faculty and researchers who are involved in precollege education, developing effective new courses and curricula, and their effective distribution, and putting in place a strong assessment and evaluation component so that we know what works and what does not, and last but not least, attracting and retaining more female, black, Hispanic and Native Americans, and disabled students into these very important professions.

The statewide systemic initiative, which we just initiated and announced in conjunction with the National Governors Association, is designed to support wholesale reforms in the quality of math and science education at the State level. The reason for mentioning it is that we are not only concerned with individual projects and programs, but are essentially trying to help change the system in total.

This program and others which I hope I have a chance of mentioning later during the question-and-answer session augment existing activities designed to increase collaboration both within the public sector and between the public and private sectors.

For instance, we have been able to enlist the resources of the publishing industry to assist schools, school districts, and curriculum development teams across the Nation in developing new teaching materials.

NSF and the Department of Education are also looking for other opportunities to collaborate in the area of informal education, particularly in public television programming.

UNDERGRADUATE EDUCATION

Another area of increased NSF activity that deserves mention is undergraduate education. Our efforts in this area are designed to

both recruit and to retain students in science, mathematics, and engineering education and continue their involvement in these areas from elementary school and high school on.

These programs serve not only 4-year and doctoral institutions, but 2-year and community colleges as well. Like the Foundation's precollege efforts, our undergraduate programs are comprehensive, ranging from new curriculum development to providing for student experiences in research, to instructor improvements, and many more activities.

In closing, let me state that I believe we are entering a new era with respect to math, science, and engineering education and human resource development, an era of greater cooperation and a more comprehensive effort to improve education and develop our human resources to their fullest.

I believe that the Foundation has recognized and responded to the need to provide leadership in the area of math, science, and engineering education and human resource development in this new era. Since 1987, that component of our budget has increased by 250 percent, thanks in part to the actions and support of this particular committee.

Thank you very much.

Senator MIKULSKI. Thank you, Mr. Bloch, and we note that in the testimony given by several of the panelists so far mention is made of Dr. Luther Williams, the new head of the education component of NSF.

Is Dr. Williams with us today?

Mr. BLOCH. Yes, he is.

Senator MIKULSKI. Would you like to just introduce him?

Mr. BLOCH. Sure. Maybe he can join us, in fact.

Senator MIKULSKI. Certainly.

Dr. Williams, please come up to the table. You are going to be the point person. We welcome you and we congratulate you on your new appointment.

[The statement follows:]

STATEMENT OF ERICH BLOCH

Madam Chair, I appreciate the opportunity to testify before this Committee on the subject of science, mathematics, and engineering education. At a time when this Nation is facing many pressing problems with respect to its economic competitiveness, the development of a scientifically skilled workforce and a scientifically literate public is vital to meeting the challenges of technological change and a knowledge-intensive global economy.

I particularly want to commend this Committee for its strong and consistent support for basic research and for its interest in the broad range of issues, including education and training, that affect the productivity of our research system and the competence of our science and engineering workforce.

Education and Human Resources: A National Concern

Since this Committee is well-acquainted with the status of science, mathematics, and engineering education in this country, I need not dwell in detail on the problems we face. However, it is important to stress that these problems are not limited to one stage of the educational process; they pervade all levels. We have serious problems at the precollege level, both in terms of the quality of instruction and the quantity of students interested in science and mathematics. International comparisons of the performance of students in the sciences and mathematics routinely place Americans toward the bottom of the list.

Student interest in the sciences and engineering has also been declining at the undergraduate and graduate levels. Demographic trends are likely to aggravate this situation through the beginning of the next century. The college age population is declining. Equally important, women and minorities -- two groups with historically low participation rates in the sciences and engineering -- are becoming larger parts of the labor force.

Roles and Responsibilities

The Nation's educational system is diffuse and decentralized, with primary responsibilities located at the state and local levels. It is, therefore, at the state and local level that our national effort must be directed. Nevertheless, as was made clear at the recent education summit between President Bush and the governors and reaffirmed at the meeting of the National Governors' Association in February, our success in improving the performance of our students depends on contributions from all institutions -- state, local, and federal; public and private. It also depends on a commitment to excellence in achievement on the part of every parent, teacher, administrator, and student.

President Bush and the governors have challenged the Nation with an ambitious goal for science and mathematics education:

> "By the year 2000, U.S. students will be first in the world in science and mathematics achievement."

Achieving this goal will require a fundamental transformation of our assumptions, our strategies, our habits, and, indeed, our culture to produce a durable transformation of the educational process, a transformation that must emphasize excellence, coherence, and continuity.

Throughout the Nation, there is understandable frustration at the pace with which education reform is realized. However, "quick fixes" that fail to take into account the complexity and diffuseness of our educational system and the necessary involvement of the federal, state, and local governments, parents, local school boards, businesses, and communities are suspect, not desirable, and not believable.

The National Science Foundation is strongly committed to exercising strong leadership to improve the science and mathematics competence of our students and to increase the size and quality of our scientific workforce. NSF performs a unique and strategic role in this area. It is charged with improving and strengthening the national capacity for research in the sciences, mathematics, and engineering. NSF has a similar charge with respect to excellence in science, mathematics, and engineering education. This includes the responsibility to monitor the health and quality of our achievement and performance in these areas.

NSF's dual mission in research and education underscores the interdependence of research and education in this country, a unique arrangement that has resulted in the development of an enormously creative and productive academic enterprise. Our research and education programs are pursued, therefore, in a complementary and synergistic manner. Specifically, our educational mission includes:

- precollege mathematics, science and technology education;
- undergraduate science, mathematics, and engineering education;
- maintenance of the science and engineering (S&E) personnel essential to the Nation's research capabilities through graduate fellowships and post-graduate activities; and
- support for other components of the S&E process, including broadening participation by underrepresented groups and institutions.

The development of our scientific talent and the enhancement of science literacy are NSF's highest priorities. NSF programs are designed to address both qualitative and quantitative deficiencies manifest at all critical points in the educational process.

NSF activities are based on the premise that high-quality education in science, engineering, mathematics, and technology must be available at every educational level. Only in this way can we prepare all students for citizenship in an increasingly technological world and enable them to make intelligent choices about their own advanced studies and careers.

NSF's role is to provide leadership and expertise and to serve as a catalyst in a national effort to introduce changes and improvements to our educational institutions. Our efforts in education are designed to be highly leveraged, to serve as models and examples for replication, and to encourage cooperation among all who play a role in the educational process. The Foundation focuses its energies on initiatives of special importance and high merit, drawing on the advice and expertise of a broad community of scientists, educators, and administrators from all levels of the educational process.

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History and Policy

NSF, through the National Science Board's Commission on Precollege Education in Mathematics, Science and Technology, developed an action plan in September 1983, "Precollege Education in Mathematics, Science and Technology." This call for action, one of the first to address the needs at the precollege level, was followed by another National Science Board report in 1986, which provided an explicit program plan for undergraduate science, mathematics, and engineering education.

NSF's Long-Range Plan for the period of FY89-93 and the Strategic Plan for FY90-94 articulated the basis for Foundation programs in science and engineering education. The latter action plan, "Enhancing the Quality of Science, Mathematics, and Engineering Education in the United States," stipulated the following policy and objectives:

- Expanding excellence in science, mathematics, and engineering instructions at all levels, and encouraging higher expectations of student and institutional performance;
- Developing attractive and effective new courses and curricula that provide consistent and coherent mathematics and science alternatives for consideration by those who administer education programs;
- Increasing the effectiveness of new teachers, faculty members, and supervisors;
- Developing the means for lowering science and mathematics avoidance rates of female, minority, and disabled students, while stimulating their interest in scientific and technical careers; and
- Increasing the number of university faculty and researchers who give attention and effort to the improvement of science, mathematics, and engineering education, not just at the undergraduate level, but also, and particularly, at the precollege level.

NSF Establishes Directorate for Education and Human Resources

On June 1 of this year, NSF announced its plans to strengthen its support for science, mathematics, and engineering education by establishing a new Directorate for Education and Human Resources (EHR). The Directorate will have broad responsibility for managing all of NSF programs in education and human resources, from pre-college and informal science education activities to undergraduate and graduate training and beyond. All existing programs in the former Science and Engineering Education (SEE) Directorate will be maintained, while programs for women, minorities, and the disabled will be relocated from elsewhere in the Foundation to the new EHR Directorate.

This reorganization will undoubtedly improve coordination and management of the Foundation's entire science education enterprise as well as its working relationships with other agencies and state and local government. The changes are consistent with recommendations made by a variety of groups, including the congressional Office of Technology Assessment in its report "Educating Scientists and Engineers: From Grade School to Grad School."

Dr. Luther Williams, formerly Senior Science Advisor for the Foundation, has been named the Assistant Director for the newly created Directorate. In his new capacity as Assistant Director for EHR, Dr. Williams will serve as Chairman of the NSF Education and Human Resources Policy Committee, with responsibility for Foundation-wide planning in the EHR area and for the disciplinary research programs. Dr. Williams, former President of Atlanta University, is a leader in efforts to improve educational opportunities for minority students. Dr. Williams served as Director of the Minority Center for Graduate Education at Purdue University from 1977-80 and as a member of the White House Advisory Committee on Historically Black Colleges and Universities and the U.S. Government Task Force on Women, Minorities, and the Handicapped in Science and Technology. Dr. Williams is also Vice Chair of the Committee on Education and Human Resources, a new committee created under the auspices of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET).

NSF Activities in Education and Human Resources

Since 1982, the National Science Foundation has dramatically increased support for education at all levels, from $34 million in FY1982 to $357 million in FY1990. [See Appendix 2.] During this period, education and human resources (EHR) increased from 3 percent to 17 percent of NSF's total budget. For FY1991, NSF has requested a 30 percent increase for EHR to $463 million. EHR is, in fact, the fastest growing part of NSF's budget and currently accounts for 20 percent of the Foundation's entire budget. Even though NSF as a whole received only half its requested increase for FY1990, science education grew by 23 percent over the FY1989 level. As a result of these increases, the number of students supported by NSF at all levels has about tripled since 1983. [See Appendix 3.]

These increases for science and engineering education are significant not only for NSF, but within the broader federal context as well. In the President's FY1991 budget, NSF represents about 45 percent of the total federal investment in programs specifically targeted on science and engineering education and human resources. While the Administration has a commitment to double NSF's overall budget by 1993, the educational portion of the budget would be tripled by that year.

Strategy

The overall perspective that guides NSF is that the educational process is a series of interdependent and interconnected stages, with links from pre-school through Grade 12, to undergraduate and to graduate study. NSF's efforts to recruit and retain students in science, mathematics, and engineering education must recognize the inherent differences and needs that exist within each educational level as well as its relationship to and impact on other grade levels.

NSF's overriding goal is to insure that the educational process stimulates the interest of students in the sciences and engineering, thereby assuring that the Nation has the scientists and engineers, the scientifically literate workforce, and educated public it needs for the decades ahead.

NSF programs are designed to be catalytic and to leverage the finite resources available. They are also designed to address

specific problems, opportunities, and needs central to the improvement of science, mathematics, and engineering education and training of students, teachers, and faculty at all levels. An important aspect of NSF's programs is their special emphasis on underrepresented groups, institutions, and localities, such as urban school districts, that require special focus and support.

Programs Support Education at all Levels

NSF programs are significant not just for the level of their commitment but also for the breadth of their support for the attraction and retention of students in all levels of the educational process. [See Appendix 4.]

Precollege level:

NSF's efforts at the precollege level are designed primarily to attract more students into science education while improving the quality of their exposure to math and science overall. Toward this end, NSF programs are designed to provide enrichment activities for students, bolster elementary and secondary instruction, support informal education programs, and reinvigorate elementary and secondary science and math education. [See Appendix 5 for a full description of these programs.] These programs, it should be noted, serve all students, not just those who will pursue majors and careers in mathematics, the sciences, or engineering.

NSF has put in place programs to enrich and reinforce the interest of high school students in science and mathematics. Our Young Scholars program annually provides some 5,000 students with real research experiences to stimulate their interest in science and mathematics and to help prepare them for college. NSF also seeks to bolster precollege instruction by improving the quality of precollege teaching and teaching materials. NSF has refocused its Teacher Preparation and Teacher Enhancement programs to reach greater numbers of teachers. Teacher support networks have been established to improve interaction with practicing scientists and engineers. Alliances among local teachers and schools, scientists and engineers, and colleges and universities have been created through the Private Sector Partnerships Program. Today, NSF programs are improving the subject matter competence of 12,000 elementary and secondary level mathematics and science teachers annually. Finally, through the Presidential Awards program, NSF recognizes the Nation's very best elementary and secondary mathematics and science teachers, thus enhancing the status of the entire profession. Support for these activities has increased from $1.1 million in FY1983 to $25.0 million in FY1985, $63.7 million in FY1989, and a requested $89.0 million for FY1991.

The quality of teaching also improves with the quality of new instructional materials. NSF has put in place new programs to improve the materials and curricula used to teach science and mathematics at the elementary and secondary level. NSF is also supporting the use of innovative advanced technologies to improve the effectiveness and outreach of science education programs.

Through the Informal Science and Mathematics Education Program, NSF is also effectively encouraging the publishing industry to contribute resources and to work with schools, school districts, and curriculum development teams all across the Nation. The dissemination of these new materials to school systems needs to be improved. NSF's renewed coordination with the Department of Education ensures increased dissemination of these materials

through the Department's National Diffusion Network. The NSF FY1990 budget for this activity represents a doubling of the FY1986 level.

NSF is creating a new program to reinvigorate elementary and secondary education by pursuing broad-based, fundamental changes at the state and local levels. The Statewide Systemic Initiative program, recently announced in conjunction with the National Governor's Association, will complement NSF's ongoing efforts in science education. In order to bring about major educational reform, NSF will work with states to plan and design activities that only the states can implement. These activities will, quite appropriately, build on many of the NSF-supported teacher training and curriculum development projects that are currently yielding positive results. More importantly, the States Initiative will catalyze the systemic, comprehensive changes necessary for major improvements in the teaching and learning of science and mathematics at all educational levels. The program will involve teachers, the business community, state and local education entities, federal research laboratories, as appropriate, and, in particular, the Department of Education's Eisenhower Program.

Urban areas also deserve special attention, because of the heavy concentration of population, particularly minorities. Our future success in the educational area will be heavily influenced by our ability to make positive impacts in urban schools.

It will, however, be up to the individual states to decide how they can best put together a meaningful reform effort, given the various factors that affect a particular state's educational system. It should be emphasized that the general flexibility and lack of prescription attending the congressional authorization of NSF programs permits the implementation of the Statewide Systemic Initiative. This flexibility enables NSF to stimulate and encourage comprehensive and systemic reforms in strategic and innovative ways.

Finally, to insure the highest possible effectiveness of its programs, NSF is expanding efforts to improve student, teacher, and program assessment techniques and instruments. NSF regularly encourages states and localities to avail themselves of materials and expertise developed through NSF-funded projects when they establish new standards for curricula and assessment.

As shown in Appendix 5, these are some of the pieces of NSF's total effort in elementary and secondary mathematics and science education. They represent only part of NSF's strategy. Collectively, these programs emphasize stimulating and supporting comprehensive changes in the Nation's educational systems. In its efforts to take a strategic approach, NSF experiments with and supports a wide range of activities that show promise for addressing important aspects of the problem. That is why NSF is investing in diverse projects ranging from teacher training to materials development, from research experiences for students to science enrichment opportunities and informal education, including science museums, television programs like Square One 3-2-1 Contact, and other modes of informal mathematics and science education.

Undergraduate education:

NSF's efforts in undergraduate education are designed both to recruit and to retain students in science, mathematics, and engineering education. Like its precollege programs, NSF's undergraduate programs are characterized by their comprehensiveness. All NSF Directorates participate in efforts to forge

mutually enriching relationships between education and research. Some programs are funded and managed entirely in the research directorates; others by the new Engineering and Human Resources Directorate. All are coordinated by EHR's Division of Undergraduate Science, Engineering, and Mathematics Education. NSF's total effort in undergraduate education is $90 million in FY1990, with a 48 percent increase to $134 million requested for FY1991.

NSF's programs serve a number of purposes: to make research experiences available to undergraduates; to facilitate the acquisition of research instrumentation to improve undergraduate laboratory instruction; to enhance faculty competence; and to improve courses and curricula for all students, not just those intending to pursue scientific careers.

Beginning in FY1991, the new Education and Human Resources Directorate will assume increasing responsibility for the Instrumentation and Laboratory Improvement (ILI) program. The Foundation has identified instrumentation as a key component in its strategy to revitalize undergraduate science education. ILI supports projects to generate more effective and efficient approaches to laboratory and field-based instruction across a wide range of disciplines, including the physical sciences, biology and social sciences, engineering, computer science, mathematics, and interdisciplinary areas. Substantial cost-sharing by awardee institutions, states, equipment manufacturers, and other elements of the private sector maximize the effectiveness of scarce federal resources.

The Foundation's ILI and other undergraduate programs serve not only four-year and doctoral institutions but two-year and community colleges as well. These institutions participate directly in NSF programs and use materials developed by NSF curriculum and laboratory development activities.

Graduate level:

At the graduate level, the Foundation's activities are devoted specifically to training technical personnel for the Nation's critical research activities, be they in academia, government, or industry. These activities include:

- A trio of graduate fellowship programs -- the regular fellowship program, the Women in Engineering program, and minority fellowships -- provides direct support to nearly 3,000 of the Nation's ablest graduate students preparing for careers in the sciences and engineering.

- NSF's research grants support an additional 12,000 graduate students working with principal investigators on research projects.

- At the postdoctoral level, several programs are designed to meet the needs of our universities for qualified faculty.

Programs Focused on Underrepresented Groups:

A critical element of all NSF education and human resource programs is a strong concern for increasing the participation of underrepresented groups, that is, women, minorities, and the disabled, in the sciences and engineering. Demographic trends clearly show that minorities and women will soon constitute a significantly increased portion of the workforce. Without substantial improvements in this area, this Nation will be seriously handicapped in its efforts to recruit and retain the new scientists, mathematicians, and engineers needed to meet the challenges of the highly competitive global economy.

The Foundation has established a number of cross-program efforts to increase the participation of women, minority, and disabled students in the sciences and mathematics. Two special NSF task forces, one on women and another on minorities, have submitted reports that serve as the basis for our current efforts. A third task force on the disabled will provide a similar basis for activities to encourage participation within this group as well.

NSF has a portfolio of programs designed to increase both the numbers of minority students and the quality of science and mathematics education they receive. These programs span the entire education continuum (elementary through graduate schools); encourage systemic change; provide flexibility of program design; are comprehensive in their coverage of science, mathematics, and engineering; and emphasize interaction among cooperating groups and organizations.

For example, the Career Access Program supports prototype projects, as well as Comprehensive Regional Centers. These Centers support activities for both students and teachers and actively involve industry, business, and community leaders. The Alliances for Minority Participation Program, included as part of our FY1991 request, moves farther along the pipeline. It encourages minority students to complete their baccalaureate degrees and pursue graduate studies in science and engineering, addressing problems such as retention, support, and inadequate student preparation. Finally, the Research Careers for Minority Scholars Program promotes the entry and full utilization of talented minority students in science and engineering through support of both undergraduate and graduate research and academic enrichment programs. These programs complement our institutional support programs, such as the Minority Research Centers of Excellence and Research Improvement in Minority Institutions.

NSF programs for women stress their recruitment and retention in research careers. The FY1991 request includes a new Faculty Awards for Women program, which will recognize and support research programs of outstanding women in science and engineering. These supplements existing programs such as Research Opportunities for Women, Visiting Professorships for Women, and the Women in Engineering program.

Partnerships and Leveraging:

Cooperation among various institutions will be critical to success in bringing about a fundamental reform in science, mathematics, and engineering education. Cooperative arrangements have been built into many NSF programs. The success of the Statewide Systemic Initiatives program, for example, rests entirely on collaborative partnerships among states, localities, academia, the private sector, and the federal government.

Two other examples of NSF programs that stress cooperation are the Career Access Program and the Alliance for Minority Participation program. In particular, the Alliances program, to be initiated in FY1991, grew out of a realization that a more strategic approach is needed to attract significantly larger numbers of minorities into science and engineering. No single institution, be it higher education, industry, or the private sector, is capable of addressing this problem alone. There is a need for a collaborative effort among all of these participants. NSF's Alliances program will support efforts to increase the numbers of minority undergraduate and graduate S&E degrees by forming explicit partnerships between NSF and other sponsors, including other federal agencies, S&E industries, private foundations, and higher education institutions.

The importance of cooperation pervades NSF programs at all levels. Industrial participation has been a significant feature of the Publisher's Initiative, the prestigious Presidential Young Investigators program, and undergraduate and graduate educational programming at the Engineering Research Centers and the Science and Technology Centers.

Cooperation within the Federal Government:

The success of the entire strategy in science and mathematics education rests not only on improved cooperation between the public and private sectors but also on improved coordination among federal agencies themselves.

The National Science Foundation and the Department of Education have been working together to identify areas for potential collaboration and to remove barriers to such efforts. NSF and the Department have established a high-level, visible coordinating mechanism to deal with immediate issues and problems. Dr. Luther Williams, Assistant Secretary for Education and Human Resources, heads the Foundation's efforts in this area, and Dr. Christopher Cross, Assistant Secretary for Educational Research and Improvement, heads the Department's efforts. These officials are responsible for coordination at all appropriate levels between the Department and NSF.

This working arrangement will enable NSF and the Department to plan strategically for an effective federal effort to achieve the national goals in science and mathematics education. A report issued to this Committee in March 1990 by the Office of Science and Technology Policy identified a number of existing, complementary programs that could be improved through closer ties. In the three months since that report was released, we have made progress in the following areas:

- Cooperative support of state systems and urban districts to improve mathematics, science, and engineering education. In particular, the NSF Statewide Systemic Initiatives program will cooperate with the Department's Eisenhower Program for mathematics and science education to ensure that the funds are used most effectively for math and science programs.

- Programs for increasing participation and achievement of traditionally underrepresented and disadvantaged groups in mathematics, science, and engineering education. In particular, the Department will use its Upward Bound program funds in collaboration with NSF-funded Career Access Centers for Women and Minorities.

- Informal science education. NSF and the Department of Education have agreed to look for opportunities to collaborate, particularly in public television programming.

- Comprehensive examinations of science education reforms across the educational pipeline. For example, the National Science Foundation will contribute $2.3 million to phase II of the AAAS/2061 project; the Department $500,000. Similarly, the Department has agreed to contribute through NSF $500,000 for the Mathematics Science Education Board.

- Distribution of NSF educational materials by the ED dissemination networks.

- Research and development of educational technologies, teaching and learning strategies, and policy for mathematics and science education.

- Programs to enhance national and international assessments of student learning in mathematics and science, studies of international comparisons of precollege and mathematics and science education, and international mathematics and science educational achievement indices.

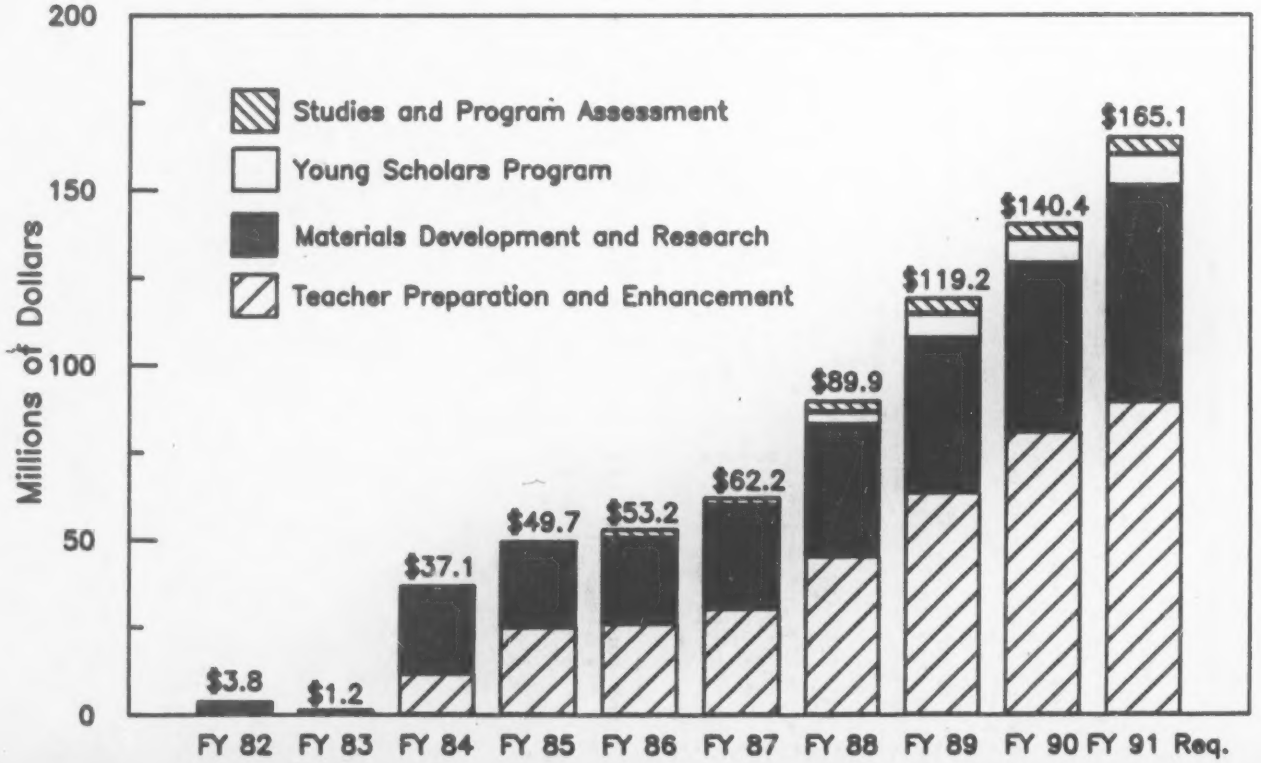
- Undergraduate level mathematics, science, and engineering education, including preparation of teachers and faculty.

While NSF and the Department of Education have well-established roles in science and engineering education, other agencies have significant contributions to make as well. NASA and the Department of Energy, for example, are responding to the need for a comprehensive national effort by increasing their focus on education.

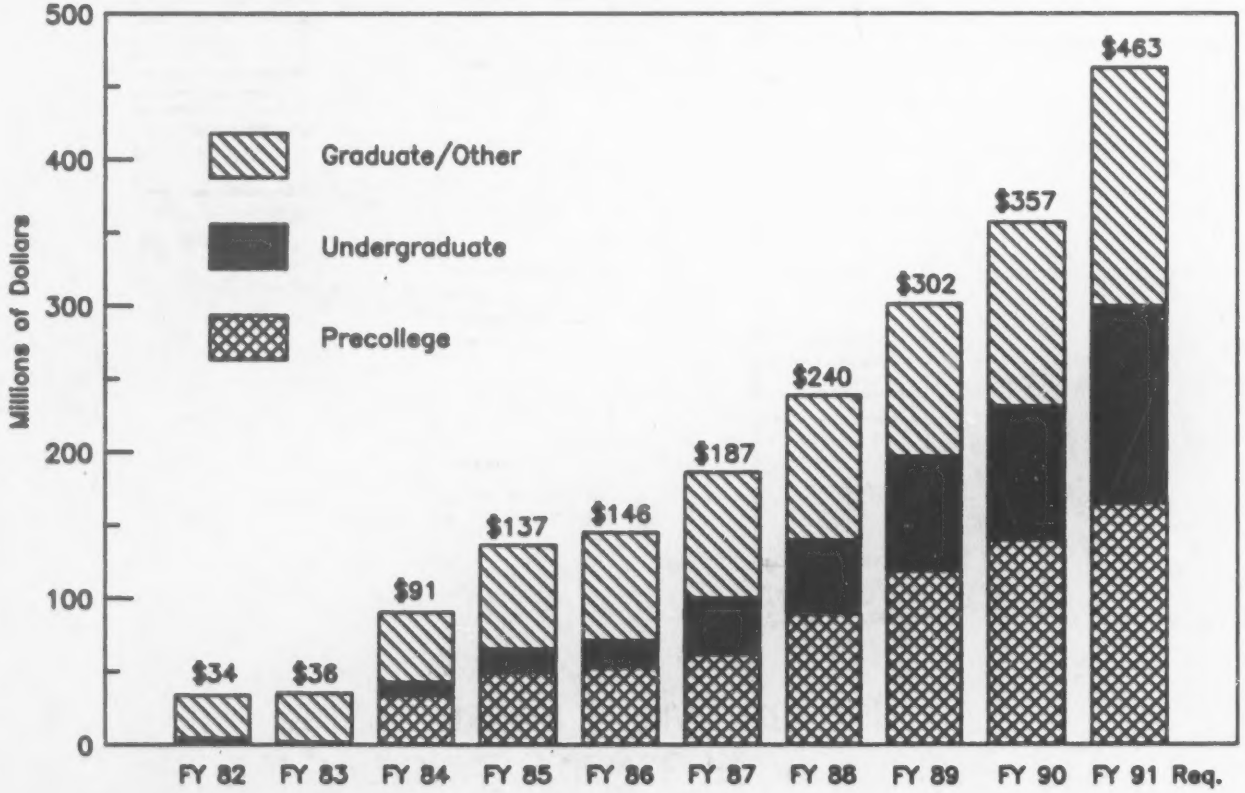
Interagency coordination will be improved by the new FCCSET Committee on Education and Human Resources. The Committee will identify areas of need, develop a truly integrated interagency effort in mathematics and science education, and work to reduce program overlap. In particular, the objective of this effort is to strengthen mathematics, science, engineering, and technology education at all levels, and to develop and maintain a technologically and scientifically literate workforce to keep the Nation internationally competitive. The Committee, created by White House Science Advisor and FCCSET Chairman Allan Bromley, is chaired by Secretary of Energy James Watkins, with vice-chairmen Luther Williams from NSF and Ted Sanders, Under Secretary of Education.

Thank you, Madam Chair. I will be happy to answer any questions you may have.

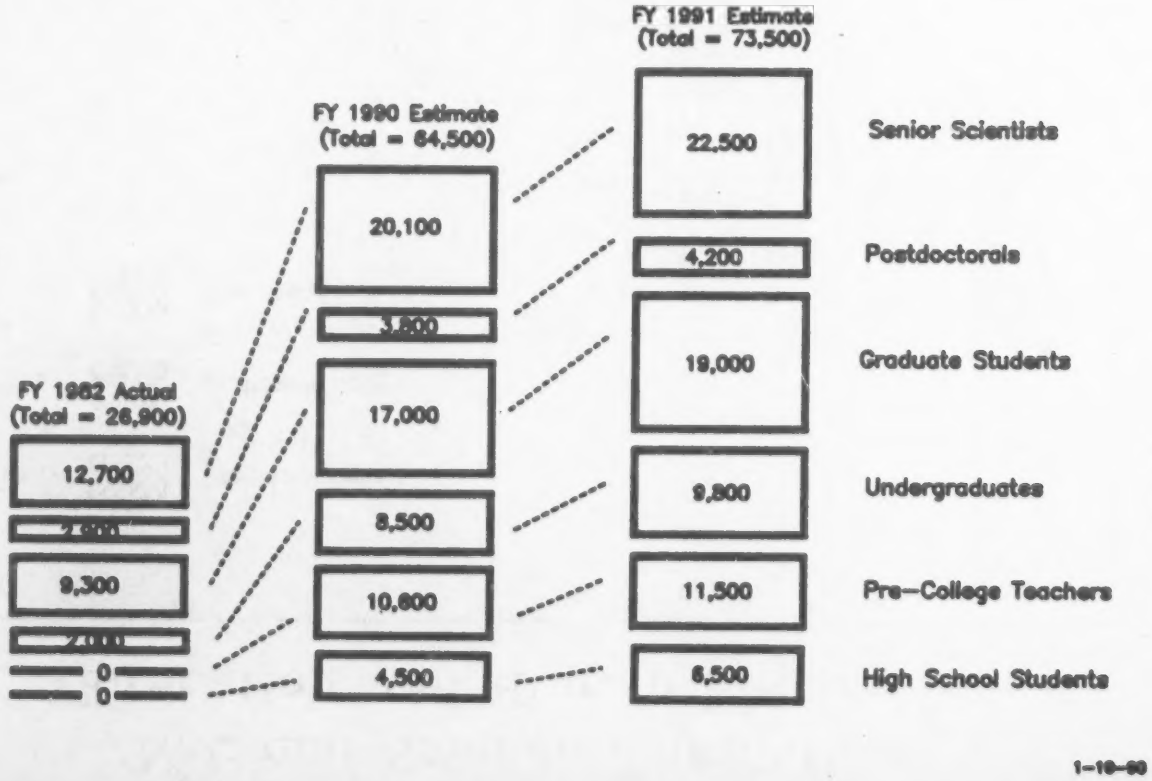
National Science Foundation
Precollege Activities, FY 1982 – FY 1991



National Science Foundation
Education and Human Resources



NATIONAL SCIENCE FOUNDATION
SUPPORT FOR HUMAN RESOURCES



Appendix 4

EDUCATION AND HUMAN RESOURCES THEME
(COMPONENTS)

Program	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90 PLAN	FY 91 REQ
PRECOLLEGE										
Teacher Preparation	0.0	1.1	11.9	25.2	26.2	30.5	45.4	63.7	81.0	89.6
Material Development & Research	3.8	0.1	23.4	22.7	24.3	29.5	37.6	44.0	48.0	61.5
Studies and Policy Assessment	0.0	0.0	1.8	1.8	2.7	2.2	3.2	4.5	4.4	5.0
Young Scholars	0.0	0.0	0.0	0.0	0.0	0.0	3.6	7.0	7.0	9.0
Subtotal	3.8	1.2	37.1	49.7	53.2	62.2	89.9	119.2	140.4	165.1
UNDERGRADUATE										
Research in Undergraduate Institution	0.0	0.0	6.7	8.8	10.7	14.6	15.9	18.6	14.9	14.9
Instrumentation and Laboratory Improvement	0.0	0.0	0.0	5.0	5.3	9.5	11.5	23.2	22.3	26.3
Course and Curriculum	0.0	0.0	0.0	0.0	0.0	0.0	3.0	6.9	16.3	35.5
Research Experiences for Undergraduates	0.0	0.0	0.0	0.0	0.0	11.9	10.4	14.1	14.2	14.5
Research Careers for Minority Scholars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.9	9.3
Faculty Enhancement	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.1	3.3	4.3
Alliances for Minority Participation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8
Career Access	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.1	11.9	15.6
Other	0.0	0.0	1.5	1.5	1.5	1.5	3.2	4.4	3.7	3.3
Subtotal	0.0	0.0	8.2	15.3	17.5	37.5	49.5	77.4	90.5	134.2

Appendix 4 (cont'd)

EDUCATION AND HUMAN RESOURCES THEME
(COMPONENTS)

Program	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90 PLAN	FY 91 REQ
GRADUATE FELLOWSHIPS	15.0	15.0	20.3	27.3	26.1	27.3	30.3	24.0	29.2	35.9
(Minority Grad)				(2.7)	(2.6)	(2.9)	(3.0)	(2.4)	(4.5)	(5.4)
NEW INVESTIGATOR INITIATIVES	0.0	0.0	8.9	17.1	24.9	33.9	40.9	49.3	49.5	60.8
WOMEN/MINORITIES (Targeted programs)										
Visiting Professorship For Women	0.9	1.9	2.1	2.1	2.1	2.0	2.3	2.3	2.3	2.7
Research Opportunities For Women	0.0	0.0	0.0	2.6	2.0	2.5	2.6	2.9	3.2	3.5
Faculty Awards-Women	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
Women in Engineering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.5
Minority Research Initiation	1.4	2.0	2.5	2.6	3.0	2.7	2.9	3.1	3.4	3.8
Research Improvement in Minority Institution	0.9	2.0	2.5	5.0	5.0	5.0	5.0	5.0	4.8	5.0
Minority Research Centers of Excellence						4.0	4.0	5.8	5.8	5.8
Subtotal	3.2	5.9	7.1	12.3	12.1	16.2	16.8	19.1	20.2	27.3
EPSCoR	3.0	2.5	0.2	1.0	2.0	4.0	6.0	8.1	9.8	9.8
OTHER										
Policy Research and Analysis	3.9	4.3	4.6	5.1	1.8	1.8	0.9	0.9	0.8	0.9
Science Resources Studies	3.1	3.7	4.2	4.1	3.9	3.9	4.0	4.3	5.0	5.0
Global Change Educ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.1
Res Training Groups	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	5.3
Special Postdocs & Other	2.2	3.0	3.5	5.0	4.0	4.0	5.0	5.0	13.8	15.5
	9.2	11.0	12.3	14.2	9.7	9.7	9.9	10.2	23.6	35.8
TOTAL EHR	$34.2	$35.6	$94.1	$136.9	$145.5	$190.8	$243.2	$307.2	$363.2	$468.9
Percent of NSF Budget	3.4%	3.3%	7.2%	9.1%	10.0%	11.8%	14.1%	16.3%	17.4%	19.7%

Appendix 5

NATIONAL SCIENCE FOUNDATION

The National Science Foundation is committed to providing strong and continuing leadership in addressing the complex predicament of science, mathematics, engineering, and technology education. Specifically, our education mission includes:

(a) precollege mathematics, science and technology education;
(b) undergraduate science, mathematics, and engineering education; and
(c) maintenance of the Science and Engineering (S&E) personnel essential to the Nation's research capabilities; and
(d) other components of the S&E pipeline, including broadening participation by underrepresented groups and institutions.

The overall strategy that guides our efforts is to impact critical stages of the educational pipeline, while strengthening linkages from pre-school through Grade 12, to undergraduate and to graduate study. All the links must be strong. The actions we take to influence the educational process at each level must recognize the inherent differences and needs that exist within each level. Our programs, as with any endeavor, are limited by a finite amount of resources, but they are designed to be catalytic and leverage these resources. They are also designed to address specific problems, opportunities, and needs inherent in improving the mathematics, science, technology and engineering education and training of students, teachers, and faculty at all levels. The over riding goal NSF has set is to stimulate the interest of students in order to ensure that the Nation will have the scientists and engineers it needs for the future and the technically literate workforce and educated public we require as we enter the twenty-first century.

Under the rubric of this overall strategy, NSF's education policy and objectives are as follows:

- Expanding excellence in science, mathematics, and engineering instructions at all levels, and supporting the acceptance of higher expectations of students and institutional performance;

- Developing attractive and effective new courses and curricula that provide consistent and coherent mathematics and science alternatives for consideration by those who administer education programs;

- Increasing the effectiveness of new teachers, faculty members, and supervisors;

- Developing means for decreasing the science and mathematics avoidance rates of female, minority, and disabled students, and increasing their interest in scientific and technical careers; and

- Increasing the number of university faculty and researchers who give attention and effort to the improvement of science, mathematics, and engineering education, especially at the precollege but also at the undergraduate level as well.

The programs described herein are representative of our strategy and consistent with the discrete program objectives for precollege, undergraduate and graduate levels of sciences, mathematics, engineering and technology education, as appropriate.

I. PRECOLLEGE MATHEMATICS AND SCIENCE EDUCATION PROGRAMS

NSF's precollege effort comprises eleven programs. The titles of these programs employ conventional terms, but the programs themselves and the projects they support are innovative and imaginative. Here, the brief description of each program is followed by a single example of a project being supported by it. Except for the absence of a program that addresses institution and system needs related to physical facilities, this set of NSF activities deals with all of the major elements of education -- all the people, all the institutions, and all the things.

1. The Teacher Enhancement Program provides support for model projects for in service improvement of the qualifications and effectiveness of mathematics and science teachers. There are hundreds of projects under this program and they reach virtually into every corner of the country. There are city projects and country projects; school projects and museum projects; and large school projects and small school projects. The projects cover a broad spectrum of characteristics and many of the more successful are attracting imitators -- which is what is supposed to happen with model projects such as these. The program will serve better than 13,000 teachers in FY 1990.

> One such project is the "Summer Institute for Science and Mathematics Teachers at Fermilab." Sixty high school biology, chemistry, physics, and mathematics teachers rubbed shoulders with some of the best scientists in the world (Fermilab hosts scientists from 18 countries). In an environment filled with the creation of new knowledge, these teachers were brought up to speed on both subject matter and teaching methodologies.

2. The Teacher Preparation Program supports innovative projects in the preservice education of future teachers of mathematics and science that address expert-identified shortfalls in the content of teacher education and the intense problems in the profession that will arise because of current demographic trends. The FY 1990 projects will provide for a steady-state production of approximately 1,300 teachers per year. The FY 1990 budget for the Teacher Enhancement and Teacher Preparation programs is $81 million.

> "A Model Program for Preparing Middle School Mathematics Teachers" is in its fifth year at Illinois State University. The project has involved a major reconceptualization based on the premise that learning mathematics is a constructive process requiring actively-facilitated problem-solving experiences. The curriculum includes innovative work in topics such as probability and statistics, mathematical modeling, geometry, calculus, and abstract algebra, and covers a well developed set of induction year activities. Over a hundred students are graduated from the program each year; they have unusual depth in mathematics and parallel sensitivity and skill in teaching middle school students.

3. The Science and Mathematics Education Networks Program supports local or regional groups organized to share information, resources, and/or talent in service of a general or specific educational objective -- often, the improvement of some aspect of the delivery of educational service. Nearly 1,800 teachers will be impacted by this program in FY 1990.

> An example of the flexibility of the Networks Program is its support under its "private sector partnerships" sub-program of "Placement of Retired Professionals in Secondary Schools for Teaching Science and Mathematics," a project of the

National Executive Service Corps. Through this experimental project, retired scientists and engineers are recruited through their professional societies to serve as volunteers in the schools of Baltimore, after appropriate training and orientation. They work under guidance of school system personnel; their performance is carefully monitored and evaluated. The record of the project will be used to prepare a "How To" book for dissemination to schools, professional societies, and businesses outlining successful procedures which could be replicated elsewhere.

4. The Presidential Awards in Science and Mathematics Teaching program is designed to demonstrate the importance of good teaching by explicitly recognizing and rewarding each year the excellence achieved by some science and mathematics teachers. Each awardee is provided with modest resources for future use and becomes part of a national network of excellent teachers.

During the first six years of its existence, this program recognized the achievements of one science teacher and one mathematics teacher from the secondary schools of each state; beginning with FY 1990, science and mathematics teachers from the elementary schools of each State will be honored similarly. These outstanding teachers exchange information about their successful programs during a week's visit to Washington, DC; afterwards they join the extensive networks of previous award winners in bringing their influence to bear on the improvement of mathematics and science education in every part of the United States.

5. The Instructional Materials Development Program supports the development of many kinds of instructional materials (in projects that range from those dealing with a few modules at a single grade level to others that are preparing new model curricula covering as many as six school years) in mathematics and science that promote the mathematics and science literacy of students at all grade levels and build a sound background for disciplinary learning in both high school and college.

One of the components of the Foundation's Instructional Materials Development Program is the NSF Publisher Initiative; its individual projects involve three-way/"triad" partnerships of publishers, schools and school systems, and academic curriculum development teams. Through the "triad projects," NSF has undertaken an integrated, large-scale effort in support of the development of a group of "baseline" curriculum packages designed to provide high quality science curriculum alternatives for elementary and middle schools. These alternatives are sequences that are appropriate for use by all students in typical school systems. They are specifically designed, developed, and marketed with the intent of reaching students whether or not they enter the learning setting with a strong interest in science.

An example is: "SUPER SCIENCE," a project of Scholastic, Inc., for grades 1-6. This is a mass media science project centered on the development of a pair of monthly magazines -- one for students in grades 1-3, another for use in grades 4-6. The magazines include readings, activities, and illustrations related to a variety of science topics; each includes charts and teacher's guide materials. The magazines are designed to meet teacher concerns that their textbooks are outdated and that it is difficult to expose students to or to involve them in enough hands-on activities and investigations of science. After two years of develop-

ment, Super Science was being used by 575,000 students in December 1989; the circulation target for that date was 300,000. Before the grant period is concluded, over 1,000,000 students are expected to read each issue. Through Super Science large numbers of students are becoming involved in hands-on science investigations for the first time; the magazines are enhancing reading among students who are reading below grade level; and teachers using Super Science find that the science content in the magazines is improving levels of reading comprehension. The evaluation also found that about half the pilot teachers in "Triad schools" use Super Science materials to strengthen instruction in mathematics, social science, and English language as well as in science. Reactions of teachers to the project are being used in planning future issues of these magazines.

6. The Applications of Advanced Technologies program is responsible for supporting research, development, and demonstration in the use of state-of-the art computer and telecommunications technologies in education. The Program seeks projects that will lay the research and conceptual foundation for technologies that will be available in five to ten years.

"Intelligent Tutors in Algebra and Geometry" is a project at Carnegie-Mellon University. It started from a technology for producing tutors that yielded a one standard deviation improvement on high school mathematics achievement. The goal of the current research is to develop and demonstrate intelligent tutoring techniques that will yield a dramatic increase in the effectiveness of intelligent tutoring -- to a three standard deviation effect. The project is half over and achieving its objectives on schedule. Much of the second half of the project is to be devoted to demonstration and dissemination of the results achieved.

7. The Research in Teaching and Learning program supports expansion of basic knowledge about the processes of teaching and learning mathematics, technology, and the sciences, and about the factors that affect success in these fields. "Expansion" of knowledge includes its dissemination as well as its creation.

A project at the University of Chicago, "Survey of Applied Soviet Research in School Mathematics Education," is publishing adaptations of selected Soviet research monographs on the principles of conceptualization, problem solving, logical reasoning, programmed instruction, mathematical abilities, and spatial perception, and related articles interpreting the implications of the research for classroom instruction in the United States. The former activity enriches U. S. research in mathematics education; the latter activity accelerates the application of useful results of research to teaching in the schools.

8. The Informal Science Education Program utilizes broadcasting, museums, science clubs and other community-centered activities to assure a balanced and rich environment that encourages informal learning across a broad range. All aspects of the ISE program are designed to stimulate and maintain self-confident interest in science, mathematics, and technology.

The "Reading Rainbow" project of Nebraskans for Public TV, in Lincoln, is an example of NSF support of science content

in an effort addressing broadly an important aspect of education. Five programs in this series are being devoted to science topics and science books. Candidate books are evaluated by scientists, educators, librarians, teachers, parents, and children -- for interest, appropriateness, readability, and suitability for television treatment. The programs produced to date have had substantial effects on homes, schools, and libraries. For example, booksellers report dramatic increases is sales of reviewed books; and librarians greatly increased requests for and use of these materials. The FY 1990 budget for the support of the aforementioned four instructional materials development and research program is $48 million.

9. The Studies and Analyses Program, budget at the level of $4.4 million for FY 1990, supports the collection and analysis of data on science and engineering education issues, and support of related policy studies and policy development. Assessment Studies assist the Foundation in a continuing effort to improve its own education activities, and to provide information for planning to colleges, universities, and governments at all levels.

A project of Horizon Research, Inc. (Chapel Hill, NC), "National Surveys of Science and Mathematics Teachers," is devoted to a related pair of national surveys. One is exploring through interviews of former teachers the factors (e.g., salary, working conditions) that influenced them to leave the profession, contrasting their attitudes toward teaching and their current occupations. The other is working through the National Assessment of Educational Progress to collect data from eighth grade science teachers on the relationships between teacher and classroom characteristics and student performance; the structure of the project assures comparability with NAEP data being collected on mathematics instruction.

10. The Young Scholars Program for talented secondary school students, which with a current budget of $7.0 million annually supports nearly 5,000 students, focuses directly on students (especially members of underrepresented groups), stimulating their interest in mathematics, science, and engineering, and helping them maintain options.

"A Rural Model for Connecting Young Scholars" is a project at Montana State University bringing high ability and high potential 8th and 9th grade students to the University for science-related career exploration activities. The project begins with a residential summer workshop of laboratory and field experiences; continues through a structured computer-network set of activities designed to connect students in their local setting with each other and with University personnel; and concludes the following year with activities that expose the students to established science programs for high achieving students in the state.

11. The Career Access Program is designed to increase opportunities in science and technology for women, minorities, and the disabled. The activities supported by the Program are Comprehensive Regional Centers for Minorities and Prototype and Model Projects, for which the FY 1990 budget is $11.9 million.

The Comprehensive Regional Center for Minorities at the University of Texas at El Paso involves in addition: El Paso Community College; the El Paso, Socorro, and Ysleta Independent School Districts; New Mexico Institute of Mining and Technology; Sul Ross State University; Western New Mexico

University; and the Texas Region XIX Education Service Center. The predominantly Hispanic minority enrollment in the colleges and universities is at least 21,000, and in the targeted school systems at least 101,000. Center emphases include: focus on critical junctures in the science career pipeline; needs and characteristics of Hispanic students; involvement of industry, business, and community leaders. Center activities for students include: summer science day camps at elementary schools; summer math/science computer camps for 8th and 9th grade students; junior and senior high school level summer institutes in science and engineering; campus visit days; summer bridge programs for community college graduates. Center activities for teachers include: summer disciplinary workshops; a science/math aides program; regional conferences for school and college educators; and career workshops for counselors.

To expand our efforts beyond those represented by the eleven programs cited above, we have decided to make provisions for mathematics and science teacher enhancement through the projects funded under the NSF Research and Related Activities account. Thus, for the Summer of 1990, a specific encouragement will be directed at NSF-supported research facilities to promote a substantial expansion of existing and start-up planned teacher-serving programs. Among such facilities are:

- the established Science and Technology Centers, Materials Research Laboratories, Engineering Research Centers, and Supercomputing Centers;
- individual specialized facilities such as the National Center for Atmospheric Research; Research Center for Energetic Materials; and the several units of the National Optical Astronomy Observatories; and
- the numerous research laboratories in colleges and universities with NSF research grants.

The numerous centers supported by the Foundation are scattered across the nation, with a distribution approximating that of the general population, and deal with numerous disciplines. The laboratories having research projects supported by NSF are very widely distributed and are active in all of the NSF disciplinary areas -- mathematical and physical sciences, computer and information sciences, geosciences, biological and behavioral sciences, and every branch of engineering.

II. UNDERGRADUATE MATHEMATICS, SCIENCE AND ENGINEERING EDUCATION

The undergraduate programs constitute the Foundation's initial instruction-related activities at that important educational level, for which FY 1990 budget is approximately $134 million.

1. The Foundation-wide undergraduate instructional Instrumentation and Laboratory Improvement Program is designed to develop and implement new approaches to improve the effectiveness and efficiency of laboratory instruction, especially through use of modern instrumentation.

Despite the growing importance of lasers and modern optics, undergraduate institutions rarely provide coursework in these increasingly pivotal areas. Lawrence University is undertaking a pilot program designed to determine the staffing and hardware requirements for meaningful instruction in lasers and modern optics in undergraduate institutions. It is developing courses at several levels, devising

suitable laboratory experiments, testing various types of lasers and optical hardware, and developing instructional materials. Publications, visits, workshops, and outreach programs serve to inform other institutions of the details of the findings. Even before its completion, aspects of this program are being emulated at other colleges and universities.

2. The Faculty Enhancement Program supports efforts to improve the disciplinary capabilities and teaching skills of faculty members who are primarily involved in undergraduate teaching.

Grants are made to conduct regional or national seminars, short courses, workshops, or similar activities for groups of faculty members.

The Departments of Paleontology and Biology of the University of California, Berkeley, offered a short course on Dinosaurs in conjunction with the 1989 Annual Meeting of the Geological Society of America. Fifteen experts on various aspects of the Age of Dinosaurs are presented a cohesive summary of new research in the evolution, origin, phylogeny, adaptations, environments, and extinctions of dinosaurs and some of the plants and animals with which they lived. Special emphasis was being given to how to set up and teach a course on dinosaurs to undergraduate students. Courses on dinosaurs have already proven to be great motivating tools that stimulate students to learn more about earth and life sciences. Dinosaurs can also be used as a vehicle to communicate ideas on subjects as diverse as molecular biology and geophysics.

3. The Courses and Curricula Program provides support for efforts that will yield new undergraduate courses and curricula, with emphases on: involvement of research-oriented faculty; timely applications of new knowledge and technologies; re-thinking professional and pre-professional curricula; courses for non-scientists; and articulation with high school science and mathematics.

A project involving a collaboration between Duke University and the North Carolina School of Science and Mathematics is creating a new curriculum in which the calculus is taught as a laboratory course. It features an integrated computer laboratory for exploration and development of intuition, and emphasizes writing to promote student comprehension and expression. The graphical and numerical experiments place the spotlight on the student and learning rather than on the professor and lecturing. Students are responding to these activities with greater interest and are exhibiting better performance than students taught in conventional calculus courses.

4. Other undergraduate programs include Research in Undergraduate Institutions, Research Experience for Undergraduates, and Research Careers for Minority Scholars, each of which seeks to enhance the research capabilities and/or experiences of students or mathematics, science and engineering faculty members.

III. GRADUATE LEVEL AND BEYOND

The Foundation's research career development activities are the Graduate Fellowship Program and the Minority Graduate Fellowship Program. Through this prestigious pair of programs, a core group of outstanding graduate students is identified and provided extended support for advanced education.

Sylvia Lynne Sanders was awarded an NSF Minority Graduate Fellowship and elected to pursue doctoral studies in biochemistry at the University of California-Berkeley. Ms. Sander's father is a biochemist and her mother a teacher of mathematics; as late as high school, she had planned on becoming a physician. At the University of Kansas, her longstanding interests in mathematics and science led to her selecting chemical engineering as an undergraduate major. But when, as a junior, she took formal coursework in biochemistry, that field began to dominate her interests. Her thesis research is on secretory processes in yeast, with emphasis on the mechanisms for protein transport. Ms. Sanders hopes to pursue an academic career after receiving her Ph.D. -- becoming, as a professor-researcher, a role model for the next generation of black Americans.

The postdoctoral component of NSF's educational activities is the NATO Postdoctoral Fellowships in Science Program, through which outstanding recent recipients are enabled to study at over-seas research sites.

Catherine Ann Briasco took a double baccalaureate in Chemical Engineering and Chemistry at Massachusetts Institute of Technology; she applied for a NATO Fellowship while still a graduate student in Chemical Engineering at Stanford University. The award of a Fellowship made it possible for her to spend a year at the Laboratoire de Technologie Enzymatique, Universite de Technologie de Compiegne, France. There she investigated spatial distributions of recombinant cell growth, plasmid stability, and oxygen concentration in immobilized-cell gel research career in private industry; at present she is working on protein-based pharmaceuticals.

The Presidential Young Investigators Program is the young faculty component of NSF's education and research support activities. Through it outstanding young scientists, mathematicians, and engineers are help to initiate and maintain the research activities that are expected of those in tenure-track faculty positions.

Anthony R. Ingraffea earned a B.S. in Aerospace Engineering from the University of Notre Dame, but switched to Civil Engineering for his master's (Polytechnic Institute of New York) and Ph.D. Degrees (University of Colorado at Boulder). At the time of his application to be a Presidential Young Investigator (PYI), Dr. Ingraffea was Associate Professor and Manager of Experimental Research in the School of Civil and Environmental Engineering at Cornell University. During his tenure as a PYI, he did creative work in computer graphics -- integrating research and teaching functions. NSF's support of Dr. Ingraffea's PYI activities was matched by funding from three major industrial companies.

IV. PROPOSED OR RECENTLY INITIATED PROGRAMS

1. Statewide Systemic Initiative

Based on our experiences with other programs, we decided that NSF needed to become more visible at the State and local levels with innovative efforts to create partnerships with States, localities, academia, and the private sector to bring about a fundamental reform in mathematics and science education. With our FY 1991 budget, NSF will actively encourage proposals that seek to put in place broad-based fundamental changes at the State and local levels that will complement ongoing efforts. We believe these

efforts can substantially improve elementary an secondary science and mathematics educations over the long terms.

This is the rationale for our Statewide Systemic Initiative recently announced in conjunction with the National Governor's Association. With this effort, NSF will take the next leadership step by working with the States to plan, design, and take action that only the States can take to bring about major educational change. They will, quite appropriately, build on the education improvement efforts that are beginning to yield positive results in many of the NSF-supported teacher training and curriculum development projects. More importantly, the States Initiative has as its purpose "to make happen" the systemic, comprehensive changes necessary for major improvements of the teaching and learning of science and mathematics at all educational levels. The program involves teachers, the business community, the State and local education entities, and, in particular, the Eisenhower Program of the Department of Education.

2. Alliance for Minority Participation Program

This strategy to effect fundamental change in education and human resources is also evidenced by our FY 1991 proposal to initiate the Alliance for Minority Participation Program. This program grew out of our realization that, despite the many efforts to improve participation of minorities in the Nation's science and technology enterprise, minorities remain severely underrepresented in science and engineering. Obviously, a more strategic approach is needed to attract a significantly increased number of minorities into science and engineering. Substantial process is essential; the demographics clearly show that a significantly increased portion of the S&E workforce will be represented by minority scientists and engineers.

However, attacking this problem successfully can not be done solely by NSF, higher education, industry or the private sector alone. Rather, there has to be a collaborative effort between all of these participants. This has lead to NSF's Alliances program to support efforts that concentrate on increasing the number of undergraduate and graduate S&E degrees received by minority students, by the formation of explicit partnerships between NSF and other sponsors (e.g., other Federal agencies, S&E industries, private foundations, higher education institutions).

These two programs are examples of NSF efforts to attack the science and mathematics education problem in a concerted and comprehensive fashion. We also have similar comprehensive efforts targeted at the undergraduate curricula for engineering, mathematics, physics, chemistry, computer science, biology, and the geosciences. All these efforts are structured on the premise that our programs must focus on each of the critical decision making points along the education spectrum if we are going to make a difference in the science, mathematics, and engineering education and training of today's and tomorrow's educated citizenry.

DEPARTMENT OF EDUCATION

STATEMENT OF CHRISTOPHER T. CROSS, ASSISTANT SECRETARY FOR EDUCATIONAL RESEARCH AND IMPROVEMENT

INTRODUCTORY REMARKS

Senator MIKULSKI. We would like to now turn to Mr. Christopher Cross, the Assistant Secretary for Education, who heads up the research and improvement area at the Department of Education. We welcome you, and also we will convey to you that Dr. Cavazos has an open door with us at any time he would choose.

We want to be careful that we are not acting like authorizing committees here today, but we are cutting across all the lines. I would like to say that very able people, Senator Kennedy and Senator Hatch in Education and Labor, as well as Senator Pell and Senator Kassebaum, are moving aggressively in this area, and we look for their advice and guidance in authorizing legislation.

So Mr. Cross, we turn to you to hear what the Department of Education is going to do and is doing in this area of interest?

Mr. CROSS. Thank you, Madam Chair.

Let me first ask that the full statement be submitted for the record. I will summarize it. The written statement includes a number of specific items of collaboration between the Department and the National Science Foundation that I would draw your attention to.

DEPARTMENT INITIATIVES

Let me spend the majority of my time talking about the initiatives which the Education Department has been undertaking in this area. For fiscal year 1991, the President has requested an appropriation of $292 million for Department programs directly affecting mathematics and science education. That is an increase of $112 million.

In addition, many of our other programs, such as chapter 1, have strong mathematics and science components. Our budget request is a reflection of the importance that the President places on mathematics and science education.

PROGRAM PRIORITIES

To make these additional resources count, we must carefully target their use. We have set the following priorities for our program efforts. Some examples are provided with each priority.

First, we must improve the teaching of science and mathematics. Teachers must have solid content knowledge and awareness of the most effective instructional practices. To this end, the President has requested $230 million for the Dwight D. Eisenhower Mathe-

matics and Science Education Program, an increase of 70 percent over the current year.

Most of the Eisenhower grants to States and local districts is for activities to improve mathematics and science teaching in order to raise the educational attainment levels of American students in math and science, and increase opportunities for women and minorities in these fields.

We are also requesting funds for research centers, which will include a center for research on mathematics teaching and learning and another center for research on teaching and learning of science. We also currently support a research center on the use of technology in education.

Second, we must encourage systematic change throughout the educational system, both through research and through improved use of existing resources, to improve science and mathematics instruction and learning. A number of instances of cooperative efforts with NSF I have already mentioned. We are also looking at ways for NSF to gain access to our dissemination networks, such as the ERIC clearinghouse, the national diffusion network, and the regional educational laboratories.

NSF is also contributing to the groundbreaking 1990 National Assessment on Educational Progress, which will provide comparable data State by State on what eighth graders know and can do in mathematics.

Third, there must be educational access for all of our citizens, with special emphasis on minorities and women. We are requesting an increase of $9.5 million in fiscal year 1991 for the Upward Bound Program to provide for a mathematics and science initiative that is being developed in consultation with NSF.

Another effort of special note is the Minority Science Improvement Program. This program is designed to enhance the capacity of institutions of higher education to develop and maintain high-quality science education programs, as well as to increase the representation of ethnic minorities in science and engineering careers.

Fourth, science and mathematics must be for all students, whether they aspire to be scientists or not. But a citizenry that understands and appreciates science must be our goal. For this priority, I would be remiss if I did not mention chapter 1, the Department's largest elementary and secondary education program.

Chapter 1 reaches over 90 percent of the school districts in the Nation and one out of nine students enrolled in U.S. elementary and secondary schools, providing substantial amounts of remedial instruction in mathematics as well as reading. Because of that, it is a major part of our attempts to ensure access to mathematics and science education for all students.

NATIONAL SCIENCE SCHOLARS PROGRAM

A new initiative and a continuing program should also be noted. As part of the President's educational excellence bills, H.R. 1675 and S.695, the proposed National Science Scholars Program would provide scholarships to graduating high school students who have excelled in the sciences and mathematics. The scholarships would recognize the academic achievement of these students and encour-

age them to continue their education in these academic areas at the postsecondary level.

From the initial request of $5 million in fiscal year 1991, the program would increase to $20 million by fiscal year 1994.

The other program is the Graduate Assistance in Areas of National Need Program, for which the President is requesting $25.5 million, $9.7 million more than the 1990 appropriation. This program provides fellowships to assist financially needy natural science and engineering graduate students of superior ability.

More can and should be done. The Department of Education supports a variety of institutional resources that can play increasingly important roles in promoting improvement in mathematics and science education through research, dissemination, and technical assistance.

Mechanisms are now in place to integrate these efforts with NSF's excellent developmental, network-building, and systematic reform programs. With assistance from other agencies, such as the Department of Energy and NASA, a truly national effort is underway.

Thank you. I look forward to answering any questions you might have.

Senator MIKULSKI. Thank you, Mr. Cross.

[The statement follows:]

STATEMENT OF CHRISTOPHER T. CROSS

Madam Chairman. I want to thank the Senate Appropriations Subcommittee on Veterans' Affairs, HUD and Independent Agencies for this opportunity to discuss the Department of Education's proposed fiscal year 1991 science and mathematics education efforts. Dr. Bromley has already outlined the national education goals established by the President and the Governors. Mathematics and science are key elements in these goals, and unless we as a Nation do far better in these areas than we have been doing, the national goals will not be achieved. The Department of Education is ready to accept this challenge and, in concert with the Office of Science and Technology Policy, the National Science Foundation, the Department of Energy, and other agencies is preparing a plan of action to achieve these goals.

The Department of Education fully endorses Dr. Bromley's statement. In addition, there are two topics I would like to discuss briefly today. One is the specific collaborative efforts between the Department of Education and NSF, with overall coordination and encouragement from Dr. Bromley's office. The other is an overview of some of our program efforts to improve science and mathematics education.

COLLABORATION WITH NSF

The Department of Education has for many years collaborated with NSF on a variety of jointly funded projects. However, the leadership provided by Luther Williams at NSF has enabled the Department and Foundation to move together in renewed partnership. Dr. Bromley and the FCCSET Education and Human Resources Committee chaired by Secretary Watkins has provided an overall vigor to collaboration among all of our agencies. In the past six months, major steps have been taken to formalize and increase collaboration. The Secretary of Education and the

Director of the NSF have established formal mechanisms for coordination of mathematics and science education programs. The Director of NSF appointed Luther S. Williams, Assistant Director for Education and Human Resources, to chair the NSF coordination effort. I have been charged to lead ED coordination. Coordination at all appropriate levels between ED and NSF is the continuing responsibility of these high-level officials. These efforts replace previous ad hoc coordination arrangements.

Collaboration of the two agencies under this mechanism has already reached beyond coordination to the development of cooperative initiatives. In addition to FCCSET and individual projects, we have established an ED/NSF working group to explore new joint ventures and keep current efforts on track. These working arrangements are leading to better coordination of plans and funding, including co-sponsorship of national reform efforts, such as:

- Joint funding of the American Association for the Advancement of Science "2061" Phase II curriculum development projects, which will lead to alternative strategies to achieve the learning goals described in the AAAS/Project 2061 report "Science for All Americans."

- Joint funding of the National Academy of Sciences' Mathematical Sciences Education Board, which will focus initially on MSEB efforts to promote appropriate forms of student assessment. MSEB was created with the full backing of the mathematics and mathematics education communities to encourage the reform of mathematics education throughout the country. The MSEB report "Everybody Counts" lays out a broad strategy for change that is national in scope.

- We will continue to support informal mathematics and science activities, including joint funding of educational television programs.

- In addition, NSF has agreed to make available up to $1 million in fiscal year 1991 to co-sponsor two of our national research and development centers. These two centers will address a broad range of research issues in mathematics and science learning, instruction and assessment.

In addition to these joint funding efforts, agreements have been reached on the following means to enhance collaboration.

- NSF is developing descriptions of its materials and exemplary teacher professional development projects that can be shared throughout the Department's dissemination networks, such as the OERI Clearinghouse on Mathematics, Science, and Environmental Education; the National Diffusion Network; the network of Eisenhower Act science and mathematics education coordinators; regional laboratories; and technical assistance centers associated with large formula grant programs.

- The Department's Eisenhower Science and Mathematics Education programs will be encouraged to support teacher participation in NSF teacher enhancement projects at the state and local levels.

- State and local educational agencies applying to NSF for support under their systemic reform program are being encouraged jointly to use Eisenhower Act, Chapters 1 and 2, and Vocational Education Act funds to strengthen science and mathematics learning initiatives.

I am submitting for the record a report prepared at the request of the House and Senate Appropriation Sub on Labor, HHS and Education detailing these coordination efforts.

The Department of Education has also taken internal steps to foster collaboration and coordination. The Department has established a Task Force on Mathematics and Science Education, chaired by the Director of the Office of Research, which includes all major operating components within the Department. The Task Force's charge is to compile a comprehensive compendium of Department science and mathematics activities that will provide the information necessary to increase coordination with other agencies. I will be pleased to share with you its report, which is due July 31, 1990. The Task Force will also be exploring means of improving coordination with other agencies. In addition to all of the Department's offices, NSF and members of OSTP, Energy, NASA, NAS, and other agency staff have met regularly with the Task Force.

Our Task Force and FCCSET are planning for additional collaborative actions. We are currently developing a memorandum of understanding with the Department of Energy to promote collaboration between Energy's national research laboratories and state and local educational agencies funded by ED under various programs.

ED INITIATIVES IN MATHEMATICS AND SCIENCE

Let me now turn to some of the program initiatives the Department of Education has proposed. For fiscal year 1991, the President has requested an appropriation of $292 million for Department programs directly affecting mathematics and science education, an increase of $112 million. In addition, many of our other programs (e.g. Chapter 1) have strong mathematics and science

components. Our budget request is a reflection of the importance the President places on mathematics and science education.

To make these additional resources count, we must carefully target their use. We have set the following priorities for our program efforts. Some examples are provided with each priority.

First, we must improve the teaching of science and mathematics. Teachers must have solid content knowledge and awareness of the most effective instructional practices. To this end, the President has requested $230 million for the Dwight D. Eisenhower Mathematics and Science Education program, an increase of $94 million, or 70 percent. Most of the Eisenhower funding grants to States and local districts for activities to improve mathematics and science teaching, raise the educational attainment levels of American students in math and science, and increase opportunities for women and minorities in these fields. The program provides a great deal of flexibility to the states and school districts in the design and delivery of programs. As I already mentioned, States and localities will be encouraged to use Eisenhower program funds to support teacher participation in NSF's teacher enhancement and systemic change programs.

Second, we must encourage systemic change throughout the educational system, both through research and through improved use of existing resources, to promote high quality science and mathematics instruction and learning. A number of instances of cooperative efforts with NSF's systemic reform program have already been discussed, as have means for NSF to gain access to our dissemination networks, such as the OERI Clearinghouse, the National Diffusion Network, and regional educational laboratories. NSF is also contributing to the groundbreaking 1990 National Assessment of Educational Progress, which will provide national data, comparable state-by-state, on what 8th graders know and can do in mathematics.

Third, there must be educational access for all of our citizens, with special emphasis on minorities and women. We are requesting an increase of $9.5 million in fiscal year 1991 for the Upward Bound program to provide for a mathematics and science initiative that is being developed in consultation with the National Science Foundation. Under this initiative, regional "magnet" projects will be funded to provide mentoring, internships, and research experiences designed to develop the interest of Upward Bound students in mathematics, science, and engineering and prepare them for higher education.

Another effort of special note is the Minority Science Improvement program. This program provides financial assistance to projects at postsecondary institutions with predominately minority enrollments. It is designed to enhance the capacity of such institutions to develop and maintain high-quality science education programs as well as to help increase the representation of ethnic minorities in science and engineering careers.

Fourth, science and mathematics must be for all students, whether they aspire to be scientists or not. A citizenry that understands and appreciates science must be our goal. For this priority, I would be remiss if I did not mention Chapter 1, the Department's largest elementary-secondary program. Chapter 1 reaches over 90 percent of the school districts in the nation and one out of nine students enrolled in U.S. elementary and secondary schools. With just under half of these students receiving some remedial mathematics instruction, I have to think that Chapter 1 has a considerable impact on mathematics learning in America and is a major part of our attempts to ensure access to mathematics and science education for all students.

A new initiative and a continuing program should also be noted. As a part of the President's Educational Excellence bill, H.R.

1675/S.695, the proposed National Science Scholars Program would provide scholarships to graduating high school students who have excelled in the sciences and mathematics. The scholarships would recognize the academic achievement of these students and encourage them to continue their education in these academic areas at the postsecondary level. From the initial request of $5 million in fiscal year 1991, funding would increase to $20 million by fiscal year 1994. The other program is the Graduate Assistance in Areas of National Need Program, for which the President is seeking $25.5 million, $9.7 million more than the 1990 appropriation. This program provides fellowships to assist financially needy graduate students of superior ability studying areas of national need. As designated by the Secretary, in consultation with NSF and the National Academy of Sciences, all of these fellowships are devoted to areas of natural science and engineering.

More can, and should, be done. The Department of Education supports a variety of institutional resources that can play increasingly important roles in promoting improvement in mathematics and science education through research, dissemination, and technical assistance. Mechanisms are now in place to integrate these efforts with NSF's excellent development, network-building, and systemic reform programs. With assistance from other agencies, such as the Department of Energy and the National Aeronautics and Space Administration, a truly national effort is underway.

Thank you, Madam Chairman. We will be happy to answer any questions you may have.

REPORT OF THE U.S. DEPARTMENT OF EDUCATION TASK FORCE ON MATHEMATICS AND SCIENCE EDUCATION TO UNDER SECRETARY TED SANDERS

I. EXECUTIVE SUMMARY

The National Education Goals identified by President Bush place major emphasis on mathematics and science. In particular, Goals 3-5 reflect the need to markedly improve mathematics and science education. Goal 4 (Science and Mathematics) states that by the year 2000, U.S. students will be first in the world in science and mathematics achievement. Mathematics and Science are also significantly included in Goal 3 (Student Achievement and Citizenship) and Goal 5 (Adult Literacy and Lifelong Learning).

The Department of Education has major roles to play in meeting these Goals; its budget for Fiscal Year 1990 included an estimated total of over $2 billion for mathematics and science education activities, with substantial increases likely in Fiscal Year 1991 and beyond. See Table 1 for details. But because the Department is not organized by content areas, it is difficult to identify and highlight existing activities and how they would specifically aid in reaching the National Educational Goals.

In December, 1989, Under Secretary Ted Sanders organized a Task Force on Mathematics and Science Education, chaired by Milton Goldberg, Director of the Office of Research (OERI), with a representative from each organizational unit in ED. The major assignment of the Task Force was surveying the Department to catalogue program activities and related funding in mathematics and science. The full Task Force met on five occasions and conducted an inventory of programs. A sub-committee of the Task Force was also convened on three occasions to formulate specific recommendations. This smaller group - composed of the Offices of Elementary and Secondary Education (Lee Wickline), Postsecondary Education (John Childers and Lawrence Grayson), Vocational Education (Winifred Warnat), and Educational Research and Improvement (Milton Goldberg, Conrad Katzenmeyer, David Florio, Allen Schmeider), plus a member from the Office of General Counsel (Richard Mellman) - represents all of the targeted mathematics and science programs and most of the funding.

Mathematics and science, as used in this report, refers to broader content than might be found in courses with these titles given in elementary and secondary or postsecondary institutions. It includes technology, either in support of mathematics and science instruction or as a topic in its own right, and applied science, included most prominently in vocational and technical education. It also pertains to mathematics and science for everyone, not simply potential scientific personnel.

FINDINGS AND RECOMMENDATIONS

(Further elaboration of these Findings and Recommendations can be found under Section IV of this Report.)

A. Identification and Retrieval of Mathematics and Science Activities

The Department is not organized by content areas and does not collect or report substantial amounts of information on many programs. For these reasons, it is not possible to provide a comprehensive description of the Department's mathematics and

science activities or to estimate with great accuracy the amount of resources being put into mathematics and science.

RECOMMENDATION ONE. The Department of Education should establish a computerized management information system as a means of capturing information about specific mathematics and science activities in discretionary programs. Such a system must become a part of the ongoing work of program staff in a way that keeps the burden minimal.

RECOMMENDATION TWO. For programs where it is not possible to meaningfully isolate mathematics and science activities and budgets, the program staffs - with the assistance of the Office of Planning, Budget, and Evaluation - should develop criteria for estimating the amount of funds being invested in mathematics and science education.

B. Organizational Constraints

Because ED is not organized by content areas, there is no easily identifiable means to address common mathematics and science concerns or even to share information. Nor are there enough contact points that might be expected to be knowledgeable of science and mathematics activities, a matter of frustration both inside and outside the Department. This also has the effect of making mathematics and science education invisible within ED, except for targeted programs, such as the Eisenhower. Recent activities by Under Secretary Sanders and Assistant Secretary Cross have had significant results, but more remains to be done.

RECOMMENDATION THREE. Designate a Special Advisor for Mathematics and Science Education within the Secretary's Office. This individual would be charged with keeping abreast of the Department's math and science activities, advising the Secretary and Under Secretary on future programmatic directions, and providing a contact point for those inside and outside of the Department who wish information. A precedent has already been established in naming a Special Advisor for Teacher Education.

RECOMMENDATION FOUR. Create a Standing Committee on Mathematics and Science Education drawn from the Principal Offices in ED that have substantial interest and concerns in these areas. This Committee would be charged with recommending policies and programmatic plans for mathematics and science to the Secretary and Under Secretary. The committee would also be a forum for information sharing. The Special Advisor should chair this Committee.

C. Maximizing Existing ED Resources

The Department of Education has only limited control and direction over much of the resources it administers. Most of the funds are administered through formula grant programs, and many of the discretionary programs have broad missions. But the Department can evaluate its existing efforts in order to identify and disseminate promising practices and products, and encourage States and local educational agencies to do the same. The Department can also evaluate ways to strengthen and sharpen the focus of those programs that support mathematics and science, particularly the formula grant programs, including Eisenhower.

RECOMMENDATION FIVE. The Secretary should ask programs with substantial mathematics and science activities to develop a plan for identifying, evaluating and disseminating successful mathematics and science education efforts, and devising techniques

for using this information in planning for future programmatic efforts.

Further, the Department should thoroughly examine each program office that supports mathematics and science activities, and work to strengthen staffing, management, and program focus in order to foster the Department's role in promoting the National Education Goals related to mathematics and science instruction and education. In conducting this examination, the Department should seek the opinions and suggestions of all Offices within the Department, as well as interested State and local officials and professional organizations and associations.

RECOMMENDATION SIX. The Under Secretary should charge each operating unit with developing a plan for maximizing its contributions toward the achievement of the National Education Goals using its current resources, and identifying what other improvements might be possible if small amounts of additional resources were made available.

RECOMMENDATION SEVEN. The Secretary and Under Secretary should encourage all states to review how they are using Department-funded formula grants and how they could be used in ways to better emphasize mathematics and science. Of particular concern should be the possible integration of these funds with those from sources, such as the Eisenhower Program and NSF's systemic reform grants, to achieve greater impact.

D. Possible Future Initiatives

The Department of Education has no comprehensive plan for addressing needs in mathematics and science education. With the interest created by the National Education Goals and expressed in Congress, ED needs to have a clear statement of the role it sees for itself in meeting these goals, and to examine additional program activities that would be desirable, if resources were to be made available.

RECOMMENDATION EIGHT. The Department of Education should develop a comprehensive plan for future directions that addresses at least the following topic areas:

- Leadership and Public/Parental Awareness
- Research and Assessment
- Teacher Professional Development
- School Improvement
- Postsecondary Institutions
- Professional Associations, Science Societies, and Foundations
- Articulation among Educational Levels
- Volunteers

Development of this comprehensive plan should be the responsibility of the proposed Standing Committee on Mathematics and Science Education.

II. BACKGROUND

A. Charge

The President and the Governors declared at the Education Summit on September 28, 1989 that "the time has come, for the first time in U.S. history, to establish clear national performance goals, goals that will make us internationally competitive."

Following the Summit, on February 26, 1990, The White House released the six National Goals for Education. Goal 4 (Science and Mathematics) states that by the year 2000, U.S. students will be first in the world in science and mathematics achievement. Mathematics and science are also significantly included in Goal 3 (Student Achievement and Citizenship) and Goal 5 (Adult Literacy and Lifelong Learning).

In response to President Bush and the State Governors Education Summit, Under Secretary Ted Sanders on December 6, 1989, established a Departmental Task Force on Mathematics and Science Education. A copy of the Task Force Charge is attached as Appendix A. to this Report.

The Task Force was charged with accomplishing four tasks: (1) surveying Department-wide programs to ascertain program content and extent of funding related to mathematics and science; (2) surveying other Federal agencies to obtain information about program content and funding of mathematics and science; (3) developing recommendations (both content and process) for further efforts of the Task Force for his consideration; and (4) reporting those developments to him in six months.

One other source of input needs to be mentioned. The Education and Human Resources Committee of the Federal Coordinating Council for Science, Engineering, and Technology was organized during the period the Task Force was meeting and made a request for substantial program and budget information from the Department. Although this request was not directed to the Task Force, it was obviously a very similar task and for efficiency was addressed by Task Force staff. The request from FCCSET has had the effect of casting this report in budgetary terms to a greater degree than the original charge might have envisioned. However, inquiries from parties outside of the Department regarding mathematics and science activities almost always focus on the monetary resources to be devoted to these topics.

B. Task Force Membership

Under Secretary Sanders felt that mathematics and science education must be a major concern for the Department. Since the Department does not have a component exclusively charged with dealing with math and science, he established this Departmental Task Force. He requested that each Senior Officer from every Program Operating Component (POC) within the Department--and the Offices of the General Counsel, Intergovernmental and Interagency Affairs, Legislation, Management and Planning, Budget and Evaluation--assign a senior staff member to represent them on this Task Force. This staff member should be familiar with mathematics and science activities in their POC and hopefully with the broader mathematics and science issues. A list of the Department representatives is attached as Appendix B to this report.

Invitations were also extended to other Federal and professional associations to provide a representative to this Task Force. The representatives of the Federal agencies and professional associations were from The Office of Science and Technology Policy, the National Aeronautics and Space Administration, the Department of Energy, the National Science Foundation, the National Academy of Sciences, The Journal of NIH Research and the American Association for the Advancement of Science. These representatives were present for most, if not all, of the meetings. A list of these agencies and professional associations and their representative is attached as Appendix C to this Report.

C. Task Force Activities

The Task Force met on five occasions--January 24th, February 16th, March 16th, April 27th and July 20th. The major discussion item was the nature of mathematics and science activities in ED and how these might be captured and reported by the Task Force. In addition, some other relevant issues were discussed. Listed below are a few items discussed at those meetings. The Minutes from these meetings are attached as Appendix D.

- The White House representative discussed FCCSET and its proposed restructuring to include a Committee on Education and Human Resources and establishing a criteria for making the Department of Education a full-fledged member of FCCSET.

- The idea for a National Initiative in Mathematics and Science Education enlisting volunteers to work for the improvement of mathematics and science education in communities.

- Discussion of the Congressional House Hearing on Science, Research and Technology at which the Secretary of Education and the Director of NSF testified.

A sub-committee of the Task Force was also convened on three occasions to formulate specific recommendations. This smaller group - composed of the Offices of Elementary and Secondary Education (Lee Wickline), Postsecondary Education (John Childers and Lawrence Grayson), Vocational Education (Winifred Warnat), and Educational Research and Improvement (Milton Goldberg, Conrad Katzenmeyer, David Florio, Allen Schmeider), plus a member from General Counsel (Richard Mellman) - represents all of the targeted mathematics and science programs and most of the funding.

The undertaking assigned this Task Force was substantial due to the large number of programs and projects within the Department, the hundreds of awards the Department makes in a year and the thousands of past awards, and the fact that under current operating procedures many of our programs and projects do not include mathematics and science identifiers. To make the burden as small as possible, the Task Force chose to create and distribute a questionnaire. Information collected on the questionnaire was augmented with data from budget documents and existing program statements. A copy of the Inventory/Survey is attached as Appendix E to this report.

The responses provided by programs on the Inventory reflect the information they had available. No program had the resources to initiate additional data collection or summarization in response to this request.

III. DESCRIPTION OF DEPARTMENT ACTIVITIES

Budget summaries for programs that contain substantial mathematics and science activities are given in Tables 1-3. Table 1 presents programs by type, Table 2 organizes programs under POCs, and Table 3 presents programs by FCCSET categories. The contents of each Table are discussed in turn. Program descriptions are then given, organized by the categories used in Table 1; these categories are described below.

Two caveats must be stated immediately. First, many of the budget estimates have been generated by the Task Force in response to requests by FCCSET and thus had to be done very quickly. It is

likely that the accuracy of these estimates varies markedly, as discussed below. These estimates should be considered only a first, rough approximation except where they were drawn directly from ED budget documents or by aggregating uniquely identified mathematics and science projects.

Second, there has been no attempt to include student financial aid programs in these tables, although these programs obviously support mathematics and science activities as part of their broader missions. There was simply not enough time to develop estimates for the student financial aid programs.

A. Budget Summaries

To understand the U.S. Department of Education's difficulty in identifying its activities in mathematics and science education, it is necessary to recognize that ED is not organized by subject areas, which means that most program information is not kept in categories such as mathematics and science. It is also important to distinguish formula grant vs. discretionary programs, and also targeted programs vs. either those programs that are non-targeted but support uniquely identifiable mathematics and science activities, or those that have broad educational missions in which mathematics and science activities cannot be uniquely identified. The level of information on mathematics and science activities and the accuracy of budget estimates depends on the type of program being discussed.

Formula grant programs pass money on to the states or other entities. While the Department may review a description of activities to be conducted throughout a state, individual mathematics and science activities that are to be supported are not reviewed by the Department and usually the information is not even collected by the Department. Discretionary programs, on the other hand, do review specific projects at the Federal level and thus have at least the information that would be provided in applications, including budgets. Often, however, there is little more that exists unless special studies have been conducted. Seldom is there data available on outcomes, numbers of students or teachers participating, etc.

Targeted programs deal specifically with a particular area, such as mathematics and science education. Budgeted amounts are directly identified as line items. As indicated in Table 1, ED has only a few targeted programs in mathematics and science, with the Eisenhower State program by far the largest. Since these programs are targeted, general mathematics and science activities are clearly identified. However, the Eisenhower State program is a formula grant program, with very limited specific information on funded activities in the Department's files. Better information should be available shortly when results are obtained from the evaluation of the Eisenhower Program being conducted by OPBE and implementation of model reporting standards for Eisenhower State grants.

Those programs that support separate, clearly identifiable mathematics and science projects (along with other projects) are all discretionary programs, and thus application information is available. Reasonable budget estimates are possible because mathematics and science activities can be separately tallied. Most of these programs do not compile narrative information on mathematics and science activities, however, because this information was not needed previously, and there are no mechanisms in place for doing such a compilation.

The largest programs in terms of dollars spent are those programs that include mathematics and science in broader educational support missions. Most of these are formula grant programs. Here the identification and retrieval of information becomes even more difficult because there is no way to uniquely identify mathematics and science activities from the broader mission. For budgets, the best that can be done is to estimate a proportion of the total funds that are spent on mathematics and science. Estimates provided in Table 1 were furnished by program officers and are necessarily subjective because no good information exists on which to base these estimates. The exception may be Chapter 1, where a significant proportion of the program is targeted on mathematics. Previous studies have provided good estimates of the number of participants receiving mathematics instruction, which in turn can be used to estimate dollars spent for mathematics instruction. However, note OPBE's concerns with these estimates as described in a footnote to Table 1.

In summary, ED is developing a systematic method for collecting data from the states for the Eisenhower Program. Aside from this effort, ED collects and summarizes information on specific mathematics and science activities only in the targeted discretionary programs and a few other discretionary programs, such as the National Diffusion Network, FIPSE, and the Special Education research and technology programs. If the Department would find it useful, most discretionary programs could compile application information, such as projects' substantive areas and types of activities proposed. Any further information regarding discretionary programs, and any information at all regarding the formula grant programs (aside from information now to be provided in the Eisenhower State Grant annual reports), would need to be collected in the field.

Tables 2 and 3 provide different ways of viewing the Department's mathematics and science programs. As indicated in Table 2, most of the major programs that support mathematics and science education are in OESE, and are either formula grant programs or discretionary grant programs with very broad missions. Most of the discretionary programs are in OERI or OPE.

Regarding the FCCSET breakdown in Table 3, no attempt has been made to split individual programs across categories, although this could be done for many of the discretionary programs. Rather, programs have been placed in what appears to be the most relevant category. As is apparent, the Department of Education's programs are spread quite unevenly across these categories. This is partly a function of the Department's lack of information, but also reflects our poor fit to the FCCSET categories, which are based on NSF's structure. The comprehensive category is particularly large because the formula grants other than the Eisenhower State program must all be placed there.

Table 1
U.S. Department of Education Programs that Support Mathematics and Science Activities

Targeted Programs	FY 1990	FY 1991
	158.0	268.1
Eisenhower (State)	126.8	220.8
Eisenhower (National)	8.8	9.2
National Science Scholars (Proposed)	-	5.0
Minority Science Improvement	5.4	5.6
Minority Graduate Participation	1.2	2.1
National Needs	15.8	25.4
Programs with Separate, Clearly Identifiable Mathematics and Science Activities		
	62.3	65.2
Research & Development Centers	2.0	3.0
NCES	14.0	8.5
FIRST	1.5	1.5
National Diffusion Network	2.2	2.2
Regional Laboratories	3.0	7.5
ERIC	.7	.7
Fund for Innovation in Education	4.0	4.0
Star Schools	8.1	-
Javits Gifted and Talented	2.2	2.2
FIPSE	2.9	2.9
Upward Bound	3.0	12.5
Patricia Roberts Harris	8.5	9.4
McNair Post-Baccalaureate	0.2	0.2
Student Support Services	7.6	8.2
Research and Education of Handicapped	1.2	1.2
Technology for the Handicapped	.8	.8
Media and Captioning Services	.4	.4
Programs that Include Mathematics and Science in Broader Educational Support Missions		
	1,863.1	1,998.8
ESEA Chapter 1*	1,148.3	1,239.7
ESEA Chapter 2	107.3	111.5
Indian Education	29.4	30.3
Magnet Schools (Desegregation)	28.1	28.3
Magnet Schools (Excellence-Proposed)	-	25.0
Special Education--State Grants	231.0	242.0
Vocational and Adult Education	281.0	281.0
Bilingual Education and Minority Language Affairs	38.0	41.0
Totals	2,083.4	2,332.1

* This estimate is based on findings that approximately 45% of Chapter 1 participants receive mathematics instruction, while approximately 70% receive reading instruction. Based on overlap of instruction and other, non-instructional services provided, it is estimated that 25% of the appropriation supports mathematics instruction. The Chapter 1 Program Director concurs with this estimate.

The Office of Planning, Budget and Evaluation strongly objects to this estimate. They hold that

> "The assertion with regard to Chapter 1 that we can use estimates of the number of participants receiving mathematics instruction to estimate dollars spent for mathematics instruction is not true. The only information we have on Chapter 1 spending is current allocations divided by the total number of participants. We have no information on the dollars spent for mathematics, and we have no way of estimating the relative cost of providing mathematics and reading education, either for individual sites or for the program as a whole. It may cost twice as much or half as much to provide math instruction as it does to provide reading instruction; there is currently no way to determine the relative cost. Thus numbers of participants cannot provide an accurate estimate of dollars spent on Chapter 1 mathematics."

OPBE also objects to the other estimates in this category as being too subjective. Description of how these estimates were made are given in footnotes to Table 4 in Appendix F.

Table 2
U.S. Department of Education
Mathematics & Science Commitments by Program Component

Principal Offices	FY 1990	FY 1991
Office of Bilingual Education and Minority Language Affairs	38.0	41.0
Office of Educational Research and Improvement	46.5	38.8
Research & Development Centers	2.0	3.0
NCES	14.0	8.5
FIRST	1.5	1.5
National Diffusion Network	2.2	2.2
Regional Laboratories	3.0	7.5
ERIC	.7	.7
Eisenhower (National)	8.8	9.2
Fund for Innovation in Education	4.0	4.0
Star Schools	8.1	-
Javits Gifted and Talented	2.2	2.2
Office of Elementary and Secondary Education	1,439.9	1,655.6
Eisenhower (State)	126.8	220.8
ESEA Chapter 1	1,148.3	1,239.7
ESEA Chapter 2	107.3	111.5
Indian Education	29.4	30.3
Magnet Schools (Desegregation)	28.1	28.3
Magnet Schools (Excellence-Proposed)	-	25.0
Office of Postsecondary Education	44.6	71.3
FIPSE	2.9	2.9
Upward Bound	3.0	12.5
National Science Scholars (Proposed)	-	5.0
Minority Science Improvement	5.4	5.6
National Needs	15.8	25.4
Patricia Roberts Harris	8.5	9.4
McNair Post-Baccalaureate	0.2	0.2
Student Support Services	7.6	8.2
Minority Participation	1.2	2.1
Office of Special Education and Rehabilitation Services	233.4	244.4
Special Education--Research and Technology Programs	2.4	2.4
Special Education--State Grants	231.0	242.0
Office of Vocational and Adult Education	281.0	281.0
Totals	2,083.4	2,332.1

Table 3
U.S. Department of Education
Mathematics and Science Commitments
by FCCSET Categories

Categories	FY 1990	FY 1991
Precollege: Program Evaluation/ Assessment	14.0	8.5
NCES	14.0	8.5
Precollege: Formal		
Curriculum/Materials Development	15.7	17.1
Eisenhower (National)	8.8	9.2
FIRST	1.5	1.5
Javits Gifted and Talented	2.2	2.2
Research & Development Centers	2.0	3.0
Research & Education of Handicapped	1.2	1.2
Teacher Preparation/Enhancement	126.8	220.8
Eisenhower (State)	126.8	220.8
Direct Student Support	3.0	12.5
Upward Bound	3.0	12.5
Educational Technologies	13.3	5.2
Fund for Innovation in Education	4.0	4.0
Star Schools	8.1	-
Technology...for the Handicapped	0.8	0.8
Media and Captioning Service	0.4	0.4
Comprehensive	1,863.1	1,998.8
Bilingual	38.0	41.0
ESEA Chapter 1	1,148.3	1,239.7
ESEA Chapter 2	107.3	111.5
Indian Education	29.4	30.3
Magnet Schools (Desegregation)	28.1	28.3
Magnet Schools (Excellence-Proposed)	-	25.0
Special Education--State Grants	231.0	242.0
Vocational Education	281.0	281.0
Dissemination/Technical Assistance	5.9	10.4
ERIC	.7	.7
Regional Laboratories	3.0	7.5
National Diffusion Network	2.2	2.2
Undergraduate: Formal -- 4-Year: Formal		
Curriculum/Materials Development	2.9	2.9
FIPSE	2.9	2.9
Direct Student Support	9.0	15.5
National Science Scholars (Proposed)	-	5.0
McNair Post-Baccalaureate	0.2	0.2
Student Support Services	7.6	8.2
Minority Participation	1.2	2.1

Comprehensive	5.4	5.6
Minority Science Improvement	5.4	5.6
Graduate		
Predoctoral Fellowships	24.3	34.8
National Needs	15.8	25.4
Patricia Roberts Harris	8.5	9.4
TOTAL	2,083.4	2,332.1

B. Program Summaries by Type of Program

A brief description is provided for the programs with substantial mathematics and science activities, following the categorization used in Table 1. These descriptions were either generated by program staff or drawn from ED's Annual Report or budget documents.

TARGETED PROGRAMS

Dwight D. Eisenhower Mathematics and Science Program

OESE administers this Eisenhower Program, which provides funding to State educational agencies and State agencies for higher education, and through them to local educational agencies and institutions of higher education. Its purpose is to strengthen the economic competitiveness and the national security of the United States by improving the skills of teachers and the quality of instruction in mathematics and science in public and private elementary and secondary schools, and improving the access of all students to mathematics and science services.

Dwight D. Eisenhower Mathematics and Science National Programs

This program provides grants and cooperative agreements to a variety of institutions for projects of national significance in mathematics and science instruction.

National Science Scholars

To encourage achievement in the sciences by recognizing high school students and encouraging them to continue their education in this area at the postsecondary level.

Minority Science Improvement Program

Provides financial assistance to projects at postsecondary institutions with predominantly minority enrollments. It is designed to enhance the capacity of such institutions to develop and to maintain quality science education programs as well as to help increase the representation of ethnic minorities in science and engineering careers.

Minority Participation in Graduate Education

Awards grants to institutions of higher education to identify talented undergraduate students who demonstrate financial need and are from minority groups underrepresented in graduate education providing those students an opportunity to participate in a program that provides effective preparation

for graduate study.

Graduate Assistance in Areas of National Need

Provides fellowships to assist financially needy graduates of superior ability studying in areas of national need, as designated by the Secretary in consultation with the National Science Foundation, the National Academy of Sciences, the National Endowments for the Arts and the Humanities, and other appropriate Federal and non-profit agencies and organizations. For the past several years, all of these fellowships have been devoted to areas of physical science, engineering, and mathematics.

PROGRAMS WITH SEPARATE, CLEARLY IDENTIFIABLE MATHEMATICS AND SCIENCE ACTIVITIES

National Research and Development Centers and Mini-Centers

At least 10 of the centers and mini-centers are engaged in efforts to improve mathematics and science education. These include mathematics and science projects relating to teaching students at the elementary and secondary level including the disadvantaged and technology. Two centers are devoted entirely to mathematics and science.

National Center for Education Statistics

NCES furnishes data on mathematics, science, and engineering degrees, on postsecondary enrollments by field of study, on students' backgrounds and some of their educational experiences in various fields, on faculty productivity, research, teaching responsibilities in major programs, on demographic science and mathematics faculty, and information on their career pasts and their likelihood of learning the teaching profession. Another survey provides data on changes in demand for mathematics and science teachers, changes in high school graduation requirements, and characteristics of mathematics and science teachers.

Fund for the Improvement and Reform of Schools and Teaching

Created to seek out, encourage, and reward innovative projects and reforms which are providing America's elementary and secondary school students improved educational opportunities and greater achievement. Priority is given to strategies designed to yield improvements in school outcomes, especially among disadvantaged students.

National Diffusion Network

NDN is a program that helps make available to schools, colleges, and other institutions hundreds of exemplary programs, many of which are mathematics and science. In the last few years, NDN has issued a booklet of quality mathematics programs and a companion booklet of outstanding science programs. As a result of these publications, and a national network of developer-demonstrators and facilitators, thousands of NDN programs have been adopted by schools and school districts.

Regional Laboratories

Each laboratory assists regional, state and local educational policymakers and practitioners to use research and development based knowledge to improve schools. Assistance strategies include training, policy development, applied research, product development and dissemination, related to priorities established through regional needs assessment and independent governing boards. Several of the laboratories are also involved in dissemination of knowledge and model programs to educators through teleconferencing and other distance learning processes. The labs have individual projects which deal with mathematics, science and technology, with technology being the largest part.

Educational Resources Information Center (ERIC)

ERIC is a nationwide information network which acquires, catalogs and provides access to the education literature. The ERIC database contains over 650,000 documents and articles on topics related to education. Its system consists of 16 Clearinghouses, a central processing reference facility and ACCESS ERIC, a one-stop contact point for new users of the system. One Clearinghouse specifically focuses on Mathematics, Science and Environmental Education.

Fund for Innovation in Education

To provide assistance to State educational agencies, local educational agencies, institutions of higher education, private schools and other public and private agencies, organizations or institutions for projects (1) that show promise of identifying and disseminating innovative educational approaches at the preschool, elementary and secondary level, (2) that strengthen and expand computer-based education in public and private elementary and secondary schools, and (3) that use telecommunications and video resources for the instruction of public and private elementary and secondary school students for related teacher training programs for public and private school teachers.

Star Schools

This program provides support to regional partnerships for developing teaching networks that use live interactive instruction via satellite, individualized computer-assisted instruction, and videotaped instruction.

Javits Gifted and Talented

Provides fellowships to individuals of superior ability for graduate study in the arts, humanities, and social sciences. Fellows are selected on the basis of demonstrated achievement and exceptional promise. Stipends are determined in accordance with the fellow's demonstrated level of need, but may not exceed $10,000.

Fund for the Improvement of Postsecondary Education

Awards grants to assist educational institutions and agencies in improving postsecondary educational opportunities.

Upward Bound

To generate skills and motivation necessary for success in education beyond high school among low-income and potential

first-generation college students and veterans. The goal of the program is to increase the academic performance and motivational levels of eligible enrollees so that such persons may complete secondary school and successfully pursue postsecondary educational programs. The mathematics and science initiative under the Upward Bound program supports summer institutions for students participating in the program who have completed the 9th grade.

Patricia Roberts Harris Fellowships

Provides grants to institutions of higher education to support fellowships for graduate and professional education to students demonstrating financial need. It also provides fellowships and institutional support in academic and professional areas to assist minorities and women to undertake graduate and professional study in academic fields in which they have been historically underrepresented.

The Ronald E. McNair Post Baccalaureate Achievement Program

Provides opportunities for research or other scholarly activities at the institution or at the graduate centers designed to provide students with effective preparation for doctoral study.

Student Support Services

Provides grants to assist disadvantaged students, including the handicapped, with support services and instruction needed to complete their postsecondary education. A major component of the instructional services is in mathematics.

Research and Education of the Handicapped Program

Annually (FY 1990 and FY 1991) provides approximately $19.8 million for both grants and contracts in over 20 priority areas. The goal of this program is to assist research and related purposes, and to conduct research, surveys, or demonstrations, relating to the education of infants, toddlers, children, and youth with disabilities. Approximately $1.2 million annually is spent on projects in mathematics and science areas with a concentration on improvement of instructional techniques for students with disabilities. Special multi-year projects have recently been funded for comprehensive analyses of curricula and materials, and development of guidelines for educators and publishers, in K-8 mathematics and science education.

Technology, Educational Media and Materials for the Handicapped Program

Annually (FY 1990 and FY 1991) provides approximately $5.4 million for grants and contracts in eight priority areas. The purpose of this program is to support projects and centers advancing the availability, quality, use, and effectiveness of technology, educational media, and materials in the education of children and youth with disabilities, and the provision of early intervention to infants and toddlers with disabilities. Approximately $0.8 million is spent annually on projects in mathematics and science areas. Current efforts include sponsorship of national conferences on cognitive and metacognitive approaches to mathematics instruction, and research and development of interactive assessment technologies, utilizing microcomputer-based expert systems and artificial intelligence, for mathematics instruction.

Media and Captioning Services

Annually (FY 1990 and FY 1991) provides approximately $1.5 million in the Captioned Films and Videos for the Deaf program to supplement classroom instruction and provide equal access to that instruction for students who are hearing impaired. Approximately $0.4 million is spent annually on captioning of mathematics and science films and video in the physical sciences (i.e., weather, geology, earth science, physics, and chemistry) and in the biological sciences (i.e., plants and animals, the human body, and the environment).

PROGRAMS THAT INCLUDE MATHEMATICS AND SCIENCE IN BROADER EDUCATIONAL SUPPORT MISSIONS

ESEA Chapter 1

This program, authorized under Chapter 1 of Title 1 of ESEA, is to provide assistance to local educational agencies (LEA) to meet special educational needs of educationally deprived children residing in low-income neighborhoods. Its goal is to raise achievement in basic and more advanced skills, help children attain grade level proficiency and succeed in regular school programs. In 1987-88, the program involved 66,000 teachers, 4.9 million children (2.2 million in mathematics), and 14,000 LEAs.

ESEA Chapter 2

The goals for this program are designed to: (1) provide the initial funding to enable State and local educational agencies to implement promising educational programs that can be supported by state and local sources of funding after such programs are demonstrated to be effective; (2) provide a continuing source of innovation, educational improvement, and support for library and instructional materials; (3) meet the special educational needs of at-risk and high cost students; (4) enhance the quality of teaching and learning through initiating and expanding effective schools programs; and (5) allow State and local educational agencies to meet their education needs and priorities for the targeted assistance programs descried in the law.

Indian Education

(Special Programs and Projects)--To plan, develop, and implement programs and projects for the improvement of educational opportunities for Indian children, to prepare and improve the qualifications of persons serving Indian students in educational personnel positions, to encourage Indian students to acquire a higher education, and to reduce the dropout rate among elementary and secondary school students. (Formula Grants to Local Educational Agencies)--To develop and carry out elementary and secondary school programs designed to meet the special educational and cultural related academic needs of Indian children to: (1) increase academic performance with special emphasis on basis skills, (2) reduce dropout rates and improve attendance, and (3) increase the relevance of academic offerings by the schools of the cultural heritage of Indian children.

Magnet Schools

To provide grants to eligible local educational agencies for use in magnet schools that are part of approved desegregation plans and that are designed to bring together students from different social, economic, racial, and ethnic backgrounds.

Special Education--State Grants

Special Education and Rehabilitative Services administers programs to assist States in the education and rehabilitation of infants, children, youth, and adults with disabilities. OSERS also provides support for special institutions serving individuals with disabilities and it conducts research, demonstration, and training activities to improve the education and rehabilitation of individuals with disabilities.

Vocational and Adult Education

Administers programs to assist the States in meeting the education needs of the workforce and provides adults with basic and career skills. It also helps the States ensure equal access to vocational education for the disadvantaged, the handicapped, men and women entering nontraditional occupations, adults in need of training and retraining, single parents, and incarcerated adults. Adult education grants to States are used to assist educationally disadvantaged adults in pursuing a high school diploma or its equivalent and in developing basic skills, including literacy.

Bilingual Programs

OBEMLA administers programs to assist students with limited proficiency in English. Specifically, to achieve national education goals by the year 2000 it is imperative to improve the achievement of limited English proficient (LEP) students in mathematics and science at the Federal level.

IV. FINDINGS AND RECOMMENDATIONS

There is general acceptance that mathematics and science education in the U.S. has serious deficiencies. Achievement of elementary and secondary students at all levels of ability is less than is needed to remain economically competitive. Teachers are not adequately prepared in mathematics and science content, particularly at the elementary level, or in the skills to make mathematics relevant and engaging. At the postsecondary level the picture is little better. There are declining numbers of science and mathematics majors, both teaching and non-teaching, and non-majors take a limited number of mathematics and science courses. Through the educational system, concerns are particularly acute regarding the low participation of minorities and women, a potential catastrophe given the demographics of future student populations.

As the mathematics and science education crisis grows, more questions will be raised about the role of the Department of Education. Several Congressional hearings on ED's mathematics and science education efforts in the past six months are only one example of this concern. ED must have a coherent plan of action that reflects the country's needs as well as our program strengths and resource constraints. This Task Force Report is an important first step. However, there are barriers within the ED structure to developing such a plan.

A. Identification and Retrieval of Mathematics and Science Activities

While some of the Department's mathematics and science activities can be clearly identified, it is not possible to do this with the bulk of the activities or to provide highly accurate estimates of the amount of resources being put into mathematics and science.

RECOMMENDATION ONE. The Department of Education should establish a computerized management information system as a means of capturing information about specific mathematics and science activities in discretionary programs. Such a system must become a part of the ongoing work of program staff in a way that keeps the burden minimal.

There are several alternatives ED might consider in addressing this recommendation.

1. Require that all mathematics and science education awards be entered into the Grants and Contracts Management System. The GCS Management System contains an abstract, keywords, and several other lists of identifiers. An example of the printout form is given in Appendix G. This System would provide an easy means of retrieving information on project intent and dollars invested as well as a beginning point for further analysis of content. It might be possible to add some keywords specifically for mathematics and science education projects.

   The GCS Management System is currently used only for contracts, although GCS intends to extend it to grants. Also, the abstracts are quite brief, meaning that they alone could not be the source for much analysis of content.

2. Explore the development of a Management Information System exclusively for mathematics and science projects that would provide greater information and more opportunities for analysis. One such system has already been developed by Information Services in OERI that permits retrieval of information on products and outcomes, as well as content focus. A strength of such a system is that it could be used by interested groups and individuals in the field, thus permitting much broader access to our programs.

A critical question to be addressed for any computerized management system is how such a system is to be operated and maintained. Entering and updating program information is a substantial effort, which would probably have to be done by Program Staff members. It is essential that maintaining a management information system be a normal, and useful, part of the workload for programs.

A management information system will be helpful only with the discretionary grants programs where information exists regarding specific projects. In order to derive good estimates of the amounts being committed for mathematics and science in the formula grants programs (excluding the Eisenhower State and Chapter 1 programs), and several of the broad purpose discretionary programs, special efforts will need to be made.

RECOMMENDATION TWO. For programs where it is not possible to meaningfully isolate mathematics and science activities and budgets, the program staffs - with the assistance of the Office of Planning, Budget, and Evaluation - should develop and implement procedures for estimating the amount of funds being invested in mathematics and science.

B. Organizational Constraints

Because ED is not organized by content areas, there is no easily identifiable means to address common mathematics and science concerns or even to share information. Nor are there contact points that might be expected to be knowledgeable of science and mathematics activities, a matter of frustration both inside and outside the Department. This also has the effect of making mathematics and science education invisible within ED, except for the targeted programs, such as the Eisenhower.

Mathematics and science are not unique examples of this problem, of course. It is equally difficult to identify social science, history, or the arts, to mention just a few. However, the Task Force believes that the national concern in mathematics and science, as highlighted in the National Education Goals, makes them a special case at this time.

RECOMMENDATION THREE. Designate a Special Advisor for Mathematics and Science Education within the Secretary's Office. This individual would be charged with keeping abreast of the Department's math and science activities, advising the Secretary and Under Secretary on future programmatic directions, and providing a contact point for those inside and outside of the Department who wish information. A precedent has already been established in naming a Special Advisor for Teacher Education.

RECOMMENDATION FOUR. Create a Standing Committee on Mathematics and Science Education drawn from the Principal Offices in ED that have substantial interest and concerns in these areas. This Committee would be charged with recommending policies and programmatic plans for mathematics and science to the Secretary and Under Secretary. The committee would also be a forum for information sharing. The Special Advisor should chair this Committee.

The sub-committee also considered the possibilities of creating an office of mathematics and science education as well as an Operating Unit in this area. An Office of Mathematics and Science Education would have a staff of its own and an Operating Unit would also have responsibility for programs dealing with mathematics and science. It was felt that these alternatives represent more radical shifts from the current administrative structure and are not called for at this time. Rather, it would be worthwhile to explore how a Special Advisor and Standing Committee operate and determine further needs based on that experience.

C. Maximizing Existing ED Resources

The Department of Education has only limited control and direction over much of the resources it administers. Most of the funds are administered through formula grant programs, and many of the discretionary programs have broad missions. But the Department can evaluate its existing efforts in order to identify and disseminate promising practices and products, and encourage States to do the same.

ED has a substantial number of programs that could probably have greater impact on math and science education than they now have--with little or no additional resources--provided the Department takes appropriate steps to assure that they are optimally focused

and managed to achieve the National Education Goals. This is particularly true of some of the formula grant programs, including the Eisenhower State Program. A first step would be to make a careful analysis of existing activities to take maximal advantage of them.

RECOMMENDATION FIVE. The Secretary should ask programs with substantial mathematics and science activities to develop a plan for identifying, evaluating and disseminating successful mathematics and science education efforts, and devising techniques for using this information in planning for future programmatic efforts.

Further, the Department should thoroughly examine each program office that supports mathematics and science activities, and work to strengthen staffing, management, and program focus in order to foster the Department's role in promoting the National Education Goals related to mathematics and science instruction and education. In conducting this examination, the Department should seek the opinions and suggestions of all Offices within the Department, as well as interested State and local officials and professional organizations and associations.

RECOMMENDATION SIX. The Under Secretary should charge every operating unit with developing a plan for maximizing its contributions toward the achievement of the National Education Goals using its current resources, and identifying what other improvements might be possible if small amounts of additional resources were made available.

RECOMMENDATION SEVEN. The Secretary and Under Secretary should encourage all states to review how they are using Department-funded formula grants and how they could be used in ways to better emphasize mathematics and science. Of particular concern should be the possible integration of these funds with those from sources, such as the Eisenhower Program and NSF's systemic reform grants, to achieve greater impact.

D. Possible Future Initiatives

The Department of Education has no comprehensive plan for addressing needs in mathematics and science education. With the interest created by the National Education Goals and expressed in Congress, ED needs to have a clear statement of the role it sees for itself in meeting these goals that should include additional program activities, if resources were to be made available.

The Task Force was not initially charged to make recommendations regarding future programmatic initiatives for the Department of Education. However, the Under Secretary subsequently asked the Chair of the Task Force if it could develop a preliminary plan for some activities ED might undertake.

RECOMMENDATION EIGHT. The Department of Education should develop a comprehensive plan for future directions that addresses at least the following topic areas:

- Leadership and Public/Parental Awareness
- Research and Assessment
- Teacher Professional Development
- School Improvement
- Postsecondary Institutions
- Professional Associations, Science Societies, and Foundations
- Articulation among Educational Levels
- Volunteers

Development of this comprehensive plan should be the responsibility of the proposed Standing Committee on Mathematics and Science Education.

There are many activities that the Department of Education might pursue to increase its impact in mathematics and science education. Under each of the topic areas, some programmatic possibilities are listed. These should be seen not as recommendations but as a set of suggestions for discussion.

1. **Leadership and Public/Parental Awareness**

a. The Secretary and senior officers of the Department can - through public appearances, testimony, and Department-sponsored forums and meetings - keep the National Education Goals in the minds of various publics across the nation. The Department can initiate, in collaboration with national leaders and scientific and media organizations, a major public awareness campaign to inform the public of the need for educational reform, particularly for the strengthening of mathematics and science education.

b. A "national leadership task group" can be drawn together to assist the Department in its leadership role. Leaders would be drawn from major education, science, technological, business, public sector, and foundation communities interested in science and mathematics education.

c. The Department can join with the President's science and domestic policy officers and other federal agencies to make sure that Federal reform initiatives and programs are coordinated and designed to support state and local-, bottom-up - reforms.

d. The Department can issue a series of "How To" pamphlets aimed at parents and other adults on helping children with science and math.

2. **Research and Assessment**

The Department can...

a. Work to improve the National Assessment of Educational Progress to permit representative sampling of student learning with measures appropriate to <u>authenticate</u> assessment of mathematics and science achievement. This will by necessity require use of measures that stress analytical thinking, problem solving, and active, hands-on performances.

b. Sponsor additional research to identify what is effective in mathematics and science education and why. This will include new applied research activities among regional laboratories and a substantial program of support for documentation, study, and evaluation of the natural reform experiments generated by schools and teachers.

c. Sponsor center/clearinghouse efforts that will share information on assessment techniques with the states and encourage the states to strengthen and modify their student and program assessments to include appropriate measures.

3. **Teacher Professional Development**

The Department can...

a. Substantially expand the Dwight D. Eisenhower Act program to work in close cooperation with the National Science Foundation, the Department of Energy, the National Air and Space Administration, professional mathematics and science organizations, and State and/or local system reform programs and projects. Within the broader Eisenhower Program focus, add a special emphasis on the professional preparation and continued learning and professional development of elementary and middle school teachers.

b. Assist local school districts to establish professional development schools for teachers that assist in the induction of new teachers - including those entering the profession through alternate certification - and the professional enhancement of experienced teachers. Special emphasis must be placed on developing teachers from minorities, women, and individuals with disabilities.

c. Encourage and provide start-up support for school/college faculty collaboratives to promote professional exchange of ideas about curricular content and effective learning opportunities - including the dramatic improvement of undergraduate courses in science, mathematics, and engineering that form the core of secondary school teacher preparation.

4. **School Improvement**

The Department can...

a. Encourage--through support for innovation, flexibility, recognition, dissemination of promising practices, and technical assistance--the restructuring and reform of schools that will permit the flexibility necessary to attain high quality mathematics and science programs.

b. Work with the National Science Foundation, Department of Energy, and other federal agencies to enhance the capacity of the National Diffusion Network to include a substantial number of mathematics and science programs that schools may adopt. Create a special category in NDN for nationally significant mathematics and science programs and processes where acceptance is based on "promising practices," and support is provided for collecting evidence of impact.

c. Provide for a network of technical assistance through ED supported institutions that place special emphasis on mathematics and science instruction. This network will include collaboration among research centers and school systems, regional laboratories, ERIC clearinghouses, networks, and programmatic--Eisenhower Act, Chapter 1, vocational education, etc.--assistance centers and state coordinators. Develop a management information system accessible to every educational institution in the country to provide information on the current, high-quality materials and exemplary and promising practices in science and mathematics education.

d. Charge every ED program to explore and identify additional ways in which science and mathematics education activities could be focused to maximize its contributions toward the achievement of National Education Goals for mathematics and

science and reinforce state and local systemic reform initiatives. Special emphasis will be placed on programs such as Chapters 1 and 2, vocational education programs with applied mathematics and science activities, and special education. ED efforts will include support for exemplary, alternative curriculum development; recognition of outstanding programs; and documentation and research on the effectiveness of mathematics and science education applied to work and technical training.

e. Create a dissemination and implementation sub-committee of the Mathematics and Science Committee, consisting of representatives from each program office that has the potential of making a contribution to achieving the National Goals. Charge the committee with the preparation of coordinated plans for achieving the Goals.

5. **Postsecondary Institutions**

The Department can...

a. Support the establishment of a National Science Scholars program to provide merit-based undergraduate scholarships to promote the study of science and mathematics.

b. Expand the existing postsecondary programs, such as Minority Science Improvement Program and the Fund for the Improvement of Postsecondary Education, to give a stronger presence to math and science including the improvement of undergraduate science and mathematics courses taken by prospective teachers and potential scientists and engineers.

c. Encourage all postsecondary education institutional recipients of ED funds to expand outreach and incentive programs for minorities, women, individuals with disabilities. Expand Upward Bound and other Trio Programs to work in collaboration with NSF and other federal initiatives to increase the representation of underrepresented groups in the fields of science and engineering.

d. Continue to emphasize the sciences, mathematics, and engineering in its graduate fellowship programs--including the use of graduate fellowships to improve undergraduate education in those fields.

6. **Professional Associations, Science Societies, and Foundations**

The Department can...

a. Develop a program in cooperation with the National Science Foundation and other federal agencies to support, examine, and evaluate innovations in the teaching of mathematics, such as alternative ways to implement recommendations made by the National Academy of Science's Mathematical Sciences Education Board (MSEB) and the National Council of Teachers of Mathematic's Curriculum, Teaching, and Evaluation Standards .

b. Through the Eisenhower Act, Fund for Innovation in Education, and FIRST program - in cooperation with NSF, Energy, NASA, etc. - increase support for innovative strategies to increase successful science learning, such as alternative curricular frameworks to achieve the learning outlines in the American Association for the Advancement of Science's Science for All Americans proposal and the National Science Teachers Association's efforts to change the scope, sequence, and content of secondary science education.

c. Establish active partnerships and strategic funding collaborations with private philanthropic and corporate foundations which support efforts to improve schools, teaching, and mathematics and science learning within their missions.

7. **Articulation Among Educational Levels**

The Department, in cooperation with NSF's state systemic reform, career access, and other comprehensive programs, can bring together school districts, states, colleges and universities in each state through the Eisenhower Act network of science and mathematics coordinators to improve the articulation of mathematics and science education requirements across levels.

8. **Volunteers**

The Department can sponsor a nationwide program which encourages mathematicians and scientists to work in schools for science and math improvement.

E. Coordination of Activities with Other Agencies

When the Task Force was first convened, lack of coordination of program efforts among agencies was a major concern. Both the House and Senate had requested a report from the Department detailing how coordination would occur. Since that time, however, a great deal has occurred. Perhaps the most significant step has been the formation of an Education and Human Resources Committee under the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). The President's Science Advisor, Dr. D. Allan Bromley, has appointed Secretary of Energy Watkins as Chair, with the Under Secretary of Education and the Assistant Director for Education and Human Resources of NSF as Vice Chairs. This Committee will encourage and coordinate programs and policies related to science, mathematics, engineering, and technological education, training, and human resource development.

In addition to the FCCSET Committee, the Secretary of Education and the Director of the NSF have established formal mechanisms for coordination of mathematics and science education programs between the two agencies. The Director of NSF appointed his Assistant Director for Education and Human Resources, Luther S. Williams to chair their coordination effort. The Assistant Secretary for Educational Research and Improvement, Christopher T. Cross, has been charged with the coordination effort for ED. Coordination at all appropriate levels between ED and NSF is the continuing responsibility of these high-level officials. These new coordination efforts replace present ad hoc coordination arrangements.

Much has already resulted from these coordination efforts. The collection of information on the resources invested in mathematics and science education by the Education and Human Resources Committee of FCCSET is just one example. Other than to add our voice of support for their activities, the Task Force believes that events have outrun any need for us to address the coordination issue.

The Task Force gratefully acknowledges the support and participation of the Agency representatives and others that sat with the Task Force. The contributions, presentations and publications of the representatives from the Federal agencies and

professional associations were informative and helpful during the interim and final stages of our collecting, distributing and logging these Inventory-Survey data. This is an excellent example of how coordination can occur.

It is important to note that on leaving the last Task Force meeting, the NASA representative indicated his strong interest in sustaining contact with the Task Force or with whatever organization follows it. This commitment appears to be shared by the other agency representatives.

V. APPENDICES

As described throughout this Report, the following items are listed as Appendices.

A. Charge

B. Department Members

C. Agency Representatives

D. Minutes

E. Inventory

F. FCCSET Table with Footnotes and FCCSET Descriptions

G. GCMS Data Entry

UNITED STATES DEPARTMENT OF EDUCATION
OFFICE OF THE UNDER SECRETARY

DEC 6 19[illegible]

THE UNDER SECRETARY

MEMORANDUM TO SENIOR OFFICERS

SUBJECT: Establishment of a Departmental Task Force on Mathematics and Science Education

I want to enlist your assistance in addressing what I feel must be a major concern for the Department, which is the crisis in mathematics and science education. Recent testimony on legislation creating new math and science programs is one indicator of what we can do in the coming months. Since the Department does not have a component exclusively charged with dealing with math and science, I am establishing a Department-wide Task Force on Mathematics and Science Education. Milt Goldberg of OERI's Office of Research has agreed to be the Chair.

This Task Force will be charged with developing methods for sharing information about the Department's many math and science education programs. The first step should be comprehensive survey and analysis of existing ED mathematics and science programs. Goals of the Task Force might include: (1) surveying Department-wide programs to ascertain program content and extent of funding related to mathematics and science, (2) surveying other Federal agencies to obtain information about program content and funding of mathematics and science, (3) developing recommendations (both content and process) for further efforts of the Task Force for the Under Secretary's consideration, and (4) reporting to the Under Secretary about the above points due in six (6) months.

I am requesting that you assign a senior staff member to represent you on the Task Force. This individual should be familiar with the mathematics and science activities in your component, and with the broader mathematics and science issues, if at all possible. Your representative should be able to speak for you. Additional members may be designated as the Task Force proceeds with its work.

This is an important undertaking for the well-being of mathematics and science education.

Please give this request your immediate attention, and notify Dr. Andrew Pepin (732-4014) within the next week to tell him whom you have designated to serve.

Ted Sanders

APPENDIX B

MEMBERS AND REPRESENTATIVES OF THE DEPARTMENTAL TASK FORCE ON MATHEMATICS AND SCIENCE EDUCATION

John CHILDRS
Deputy Assistant Secretary, Higher Education Programs
Office of Postsecondary Education
Room 3082 - ROB/3

Sandra COOK
Legislative Analyst
Office of Legislation
Room 3153 - FOB/6

Genevieve CORNELIUS
Director, Division of Formula Grants
Office of Elementary and Secondary Education
Room 2040 - FOB/6

Alicia CORO
Director, School Improvement Programs
Office of Elementary and Secondary Education
Room 2071 - FOB/6

Alan GINSBURG
Director, Planning and Evaluation Service
Office of Planning, Budget and Evaluation
Room 3127 - FOB/6

Milton GOLDBERG
Director, Office of Research
Office of Educational Research and Improvement
Room 610D
555 New Jersey Avenue, N.W.

Lawrence GRAYSON
Acting Director, Division of Postsecondary Relations Staff
Office of Postsecondary Education
Room 3095 - ROB/3

Karen KELLY
Confidential Assistant
Office of Private Education
Room 4137 - FOB/6

Richard LaPOINTE
Director
Fund for the Improvement and Reform of Schools and Teaching
Room 522G
555 New Jersey Avenue, N.W.

Samuel McKEE
International Education Affairs Specialist
Office of Intergovernmental and Interagency Affairs
Room 3047 - FOB/6

Richard MELLMAN
General Attorney
Office of the General Counsel
Room 4099 - FOB/6

Gail NIEDERNHOFER
Administrator
Office of Management
Room 3181 - FOB/6

Valena PLISKO
Director, Elementary and Secondary Education Division,
Planning and Evaluation Service
Office of Planning, Budget and Evaluation
Room 3121 - FOB/6

Barbara RIVERS
Special Assistant to the Administrator
Office of Management
Room 1175 - FOB/6

Allen SCHMIEDER
Math and Science Director
Fund for the Improvement and Reform of Schools and Teaching
Room 522
555 New Jersey Avenue, N.W.

Judy SCHRAG
Director, Office of Special Education Programs
Office of Special Education and Rehabilitative Services
Room 3086 - Switzer

Argelia VELEZ-RODRIGUEZ
Program Director, Minority Science and Engineering
Improvement Program
Office of Postsecondary Education
Room 3022 - ROB/3

Winnie WARNAT
Director, Division of Vocational Technical Education
Office of Vocational and Adult Education
Room 4315 - Switzer

William WOOTEN
Deputy Director
Office of Bilingual Education and Minority Languages Affairs
Room 5082 - Switzer

Anne YORKE
Director, Training Development Division
Office of Civil Rights
Room 5417 - Switzer

APPENDIX C

REPRESENTATIVES FROM FEDERAL AGENCIES AND PROFESSIONAL ASSOCIATIONS ON THE U.S. DEPARTMENT OF EDUCATION'S DEPARTMENTAL TASK FORCE ON MATHEMATICS AND SCIENCE EDUCATION

Russell AIUTO, Dr. 357-7073
Director, Division of Teacher Preparation
and Enhancement
National Science Foundation
1800 G Street, N.W., Room 635B
Washington, D.C. 20550

Eddie ANDERSON, Dr. 453-8397
Chief, Education and Secondary Programs Division
National Aeronautics and Space Administration
400 Maryland Avenue, S.W., Room 6052
Washington, D.C. 20546

Deborah BARNES, Dr. 785-5333
Editor
The Journal of NIH Research
2000 Pennsylvania Avenue, N.W., Suite 3700
Washington, D.C. 20006

Robert BROWN, Dr. 453-1110
Director, Education Affairs Division
National Aeronautics and Space Administration
400 Maryland Avenue, S.W.
Washington, D.C. 20546

Donna GERARDI 334-1568
Research Associate, Board on Biology
National Research Council
National Academy Of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Chris HANUS 586-7203
Office of the Secretary
Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Mary Harley KRUTER, Dr. 456-1414
Office of Science & Technology Policy
The White House
Washington, D.C. 20500

Larry WOLDT 586-2117
Office of the Secretary
Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

April, 1990

MINUTES OF
MATHEMATICS AND SCIENCE TASK FORCE MEETING
JANUARY 24, 1990

ATTENDEES:
Ted Sanders, Under Secretary
Milton Goldberg, OERI, Chairman of Task Force

MEMBERS:

William Wooten, OBEMLA
Judy Schrag, OSERS
Winnie Warnat, OVAE
Alicia Coro, OESE
Samuel McKee, OIIA
Allan Ginsburg, OPBE
John Childers, OPE
Gail Niedernhofer, OM
Anne Yorke, OCR
Richard Mellan, OGC

OFFICE OF RESEARCH:

Conrad Katzenmeyer
Steven Kirsner
David Florio
Henrietta Moody

GUESTS:
Valena Plisko, OPBE
Lawrence Grayson, OPE
Larry Woldt, Department of Energy
Chris Hanus, Department of Energy
Mary Harley Kruter, OSTP, The White House

Milton Goldberg convened the meeting at 9:40 AM on Wednesday, January 24th. He welcomed the Members and introduced Ted Sanders, Under Secretary.

Dr. Sanders emphasized the importance of this Task Force to the goals of the Administration, to the work of the Governors and the issues stressed at the Education Summit and to the work and aim of the Department. He reminded them they have six months to establish a format for the Department. He thanked the Members for their willingness to serve.

Milt asked the Members to introduce themselves and to say a few words on the activities and interests in their offices. Their comments follow.

OCR--to investigate complaints ensuring the civil rights of women, minorities and the handicapped are not compromised; development of technical assistance and the strategies used to facilitate this.

OBEMLA--Innovative approaches for exemplary math and science in Cambridge Clearinghouse; increase of requests by grantees for assistance in content areas, particularly math and science.

OVAE--Baccalaureate education, integration of basic skills curriculum; technical preparation; adult literacy; applied academics; technical education.

OIIA--Outreach program, Federal Interagency Committee on Education; international education programs; waiver board--faculty member residency, usually in math and science.

OPBE--Evaluation of the state Eisenhower Math and Science Program; reporting standards for that Program (as required by the Hawkins/Stafford Amendment); preparing handbook--What Works in Math and Science?--for release in May, 1990.

OPE--FIPSE is involved in activities (or concerns) such as: preparing potential math and science teachers for the future; access to retention programs; improve teacher learning; curriculum; increase women's participation. MSIP addresses math and science issues in minority institutions.

Mary Harley Kruter, Office of Science and Technology Policy, The White House--pre-college math and science issue; training of technical clientele; Federal Coordinating Committee for Science, Engineering and Technology (FCCSET), members are agency and department heads with Dr. Bromley as Chair. Hoping this Committee will be an influence on the 1992 budget; Presidential Council of Advisors for Science and Technology (PCAST) non-government advisors, advising the President on education and human resources. Math and science will be a part of the national goals.

OSERS--Compatible approach to learning needs of disabled persons; how curriculum can be adopted in science for special education persons; how special education students are doing in the elementary math area.

OM--Job Fair for superior qualification hiring will be held on March 1 & 2 so we will be able to look at candidates in these special areas; OPM has a candidate referring service that we can draw on; OM will be available to help whenever needed.

OESE--The State Eisenhower Grants are administered from this office; state coordinators assigned at elementary, secondary and higher education levels; appropriate notification of Department support needs to be increased.

OGC--Provides legal assistance as requested; works quite often with OESE on Title II programs; math and science is an area of great importance.

David Florio--Growing interest in reaching out across agencies; working on interagency conference on research learning.

Larry Woldt, Department of Energy--communciation with research and technical organizations opening their research labs for summer programs to teachers and students. About 1000 participated last year, looking for 10,000 participants this year.

OERI--NDN, Star School Program; Regional Labs; ERIC Clearinghouses in math, science and environmental education, and in technology; FIRST (National Eisenhower Program); Research Centers--science, technology, and math; technology and learning; also science and math projects in many of the other R&D Centers; Center on Student Learning.

ACTUAL AND POTENTIAL ACTIVITIES:

Task Force Members expressed enthusiasm for participating in this activity, feeling that its charge is of crucial importance to the

Department and to education. Creating an inventory of science and mathematics projects will also help POCs to communicate about common interests and concerns.

Regarding the charge to the Task Force, William Wooten suggested adding the topic joint funding across the programs to the activities proposed for the Task Force. A number of Members commented that legislative constraints made these arrangements difficult in some instances. If this is accepted as an activity, the Offices of the General Counsel and Management will look into this area.

The Members suggested adding "and collaboration" to the second, third and fourth bullets of the agenda. In the second bullet, "and collaboration" follows the word "communication" and in bullets three and four, it follows the word "coordination".

The Department of Energy has requested a report from all Federal agencies on the role they are playing in math and science. We will be able to draw on this report.

The Office of Legislation was inadvertently omitted from representation on this Task Force. It was unanimously suggested that OL be contacted regarding participation and that they be asked to name of a staff person to serve on the Task Force.

The Chairman informed the Members that they will receive a draft inventory for their use in preparing their math and science reports.

The Chairman asked the Members to be thinking of non-exisiting programs--why don't they exist?

The Chairman said he would get the DRAFT inventory report to them within the week. He asked that they review/edit it and get back him so a final version can be prepared and circulated for tryout prior to the next Task Force meeting. The Chairman will be in touch about this meeting; it is scheduled for the week of February 12th from 9:30-11:00. They will be notified of the exact date.

The first meeting adjourned at 11:00 AM.

MINUTES OF
MATHEMATICS AND SCIENCE TASK FORCE MEETING
FEBRUARY 16, 1990

MEMBERS AND REPRESENTATIVES:

John Childers, OPE
Genevieve Cornelius, OESE
Milton Goldberg, OERI, Chairman
Larry Grayson, OPE
Karen Kelly, OPRE
Richard LaPointe, FIRST
Samuel McKee, OIIA
Valena Plisko, OPBE
Kay Rigling, OGC
Argelia Velez-Rodriguez, OPE
Winnie Warnat, OVAE
William Wooten, OBEMLA
Anne Yorke, OCR

GUESTS:

Deborah Barnes, Editor, THE JOURNAL OF NIH RESEARCH
Robert Brown, Director, Education Affairs Division, NASA
Chris Hanus, Office of the Secretary, Department of Energy
Mary Kruter, OSTP, The White House

OERI/OFFICE OF RESEARCH:

David Florio
Conrad Katzenmeyer
Steven Kirsner
Henrietta Moody

Milton Goldberg convened the meeting at 9:55 AM (the start of the meeting was delayed by a fire alarm) on Friday, February 16th. He welcomed the members and their representatives and the invited guests.

The Chairman asked the members to be in touch with him next week regarding their comment(s) on the content and format of the draft minutes. If no comments are made, they will be accepted as final, and the format will remain the same.

The Chairman pointed out the National Research Council's new publication, Reshaping School Mathematics: A Philosophy and Framework for Curriculum. He asked Steven Kirsner to say a few words regarding the publication.

Milt Goldberg discussed the Congressional House Hearings on Science, Research and Technology scheduled for February 28th. The Secretary of the Department and the Director of NSF will be testifying, and he promised to get the members a copy of the Secretary Cavazos' submitted statement.

The Chairman asked the members to keep each other informed of any math, science and metric-related material they may receive. He mentioned the Metric Task Force being organized by the Assistant Secretary, OESE. The articles in their packet are just a few of the items that can be found in the Department's AM and PM clips. He brought three specific articles to their attention: the Los

Angeles Times piece on TRW funding new math and science school, the Principal piece on Math and Science: A Nation Still at Risk, and the Wall Street Journal piece on raising college standards.

The Chairman asked Mary Kruter to say a few words on the Federal Coordinating Committee for Science, Engineering and Technology (FCCSET). FCCSET was established by legislation in 1976 with heads of specific agencies and departments--NSF, NASA, Energy, Commerce, Defense--as members. At their January 24th meeting, Chairman Bromley proposed restructuring the FCCSET committees to include one on Education and Human Resources. March 1st will be the date FCCSET decides which agencies will chair committees. FCCSET will also establish criteria for making the Department of Education a full-fledged member.

Milt Goldberg discussed the new publication from the National Science Foundation Board, The State of US Science and Engineering (NSB 89-2). This publication is a summary of a major data-packed document by NSF. He suggested they get a copy of the full document Science and Engineering Indicators-1989. (NSB 89-1) and discussion it at a later date.

The Chairman opened the discussion on the Inventory asking "what kinds of changes and/or modifications are needed?" This led to a lengthy discussion. The following questions/comments/recommendations were raised during this discussion.

- How do you intend to aggregate this data? Describe the activities? Will the format be compatible to data-base?.
- Some projects don't necessary fit comfortably in these categories. For example, nursing education is loaded with science, but is not a science program).
- Are there ways to stimulate other possibilities--Federal level, state level? Is there any collaboration going on now? It was stated that there were examples of collaboration noted on the inventory from Allen Schmieder. It was suggested that regarding the information around the Department, collaboration will not surface unless we begin to publish this information. Not enough within the Department is known of math and science and we need to do something. The purpose is to make judgments of what we need to do to make headway in math and science; how does the Department coordinate efforts to redirect internal efforts and policies; what purpose might make readers coordinate/colllaborate more usefully.
- Chris Hanus said they learned, during the Energy Department's processing of similar information, that more descriptions will be needed before this inventory information can be filed into a data base.
- It was asked if we wanted descriptions on individual programs, if evaluations exist and if so, what do they say.
- A recommendation was made to establish a subcommittee of the Task Force that would identify programs throughout the Department. The subcommittee could look at evaluation programs not specifically noted as math and science. The OPBE representative (Valena) said her office could help in securing information.

- It was recommended that we maintain selected information so the Department can continue calling for this information and data; that we be comprehensive with what to included before we can begin to delete from the inventory.

- Allen Schmieder provided a handout of the 1988-1989 Award Abstracts for the Dwight David Eisenhower Math and Science National Program funded out of his office. He noted 70 projects in this Program were getting at scope and numbers (see pages 5 and 6), themes and approaches are included in this listing. Descriptions and narratives can be as long or as short as you want--just as those on page 6 of this document.

- Robert Barnes, NASA, said sides are splitting from information--starving for knowledge; what benchmark will lead us towards this goal; have we put enough energy into defining this inventory?.

The Office of Legislation still did not have a representative on the Task Force. The Chairman has been in contact with Nancy Mohr Kennedy and she has assigned someone to the Committee. The name of that individual will be passed on to you as soon as it is known.

Robert Brown said that during National Engineers Week, administrators are asked to teach classes. Larry said that the geological society and DE each have had scientists in the classroom. Chris said the Department of Energy has sponsored a program to take elementary and secondary teachers (math and science) in the labs for six weeks with top scientists.

The Chairman said he remembers a time when he asked a scientist to teach a class for one day. The scientist asked the children the distance from earth to the stars. He did not talk down to the children; he stimulated their imagination. The principal was afraid the children would not be responsive.

John Childers and Larry Grayson introduced their idea for a National Initiative in Math and Science Education which would enlist 100,000 volunteers to work for the improvement of math and science education in communities throughout the country. They asked that the members get back to them with questions and/or comments on the report.

Following this discussion, the Chairman asked that the members begin to survey their programs, and that he would within the next week get to them the Inventory documents so their preparation can begin. He said they should be prepared to comment on their findings at the next meeting.

Prior to adjourning the meeting, the Chairman also said he would be in touch with them next week regarding the date for their next meeting.

The meeting was adjourned at 11:15 AM.

MINUTES OF
MATHEMATICS AND SCIENCE TASK FORCE MEETING
MARCH 16, 1990

MEMBERS AND REPRESENTATIVES:

John Childers, OPE
Sandra Cook, OL
Genevieve Cornelius, OESE
Milton Goldberg, OERI, Chairman
Larry Grayson, OPE
Laura Johns, OVAE
Karen Kelly, OPRE
Richard Mellman, OGC
Valena Plisko, OPBE
Barbara Rivers, OM
Judy Schrag, OSERS
Argelia Velez-Rodriguez, OPE
William Wooten, OBEMLA
Anne Yorke, OCR

GUESTS:

Russell Aiuto, Director, Division of Teacher Preparation and Enhancement, National Science Foundation
Eddie Anderson, Chief, Education and Secondary Programs Division, National Aeronautics and Space Administration
Donna Gerardi, Research Associate, Board on Biology, National Academy of Science
Chris Hanus, Office of the Secretary, Department of Energy

OERI/OFFICE OF RESEARCH:

David Florio
Conrad Katzenmeyer
Steven Kirsner
Henrietta Moody

Milton Goldberg convened the meeting at 9:40 A.M. on Friday, March 16th. He welcomed the Members, their representatives and the invited guests.

The Members approved the DRAFT Minutes from the February 16th meeting after the correction of two errors.

The Chairman proceeded to discuss the Information Items listed on the Agenda:

1. Secretary Cavazos' Statement before the House Subcommittee on Science, Research and Technology. Secretary Cavazos and Dr. Block, Director of the National Science Foundation, testified before this Subcommittee on February 28, 1990. The Chairman suggested the Members read both Secretary Cavazos' Statement and the next item on the Agenda, Senator Kennedy's bill on mathematics and science.

Questions and comments on Secretary Cavazos' Statement:

o A Member asked who prepared the speech for Secretary Cavazos; OPBE, the Secretary's Office, the Under Secretary's Office, OESE? It was suggested that statements and speeches by the Secretary or Under Secretary should routinely be circulated to all principal offices for their information and quotation when

and where necessary. There are staff and programs that could have something to add, delete or correct in speeches prepared for delivery by Secretary Cavazos or Under Secretary Sanders. As an example, two programs mentioned in the speech--Upward Bound and Minority Institutions Science Improvement--are either no longer in existence or exist under a different name. If programs were asked for comments, these two items could have been changed prior to the preparation of the final version of the speech. The Members asked the possibility of programs being involved in future preparation of similar documents. Sandra Cook said some programs are involved in preparation of documents, but it is the decision of the Offices of the Secretary and/or Under Secretary who and what program(s) are involved and in what area(s).

Someone asked how do we deal with speeches and issues at the Department? The answer, we deal with them issue by issue.

o Comments on the statements and speeches don't, in all instances, provide inclusions that adequately reflect the Department's position.

2. Questions and comments on Senator Kennedy's bill:

o This bill is a combination of proposals from a number of Congressmen and, as the Chairman noted, is a bill that has something for everyone. Included are; the National Institute of Technology and Learning (Smithsonian), the National Research Centers, a Clearinghouse on Assessment, and consortiums and community extensions. The National Science Foundation is listed as the lead agency for objectives ($125 million for ten years). One Member wondered where was the focal point of this bill?

o The hearing for this bill may be in April and markup is expected very quickly. Congressman Augustus Hawkins says that the bill should be referred back to Committee for consideration, and that the House is working on their own math and science bill. The problem on the Hill seems to be with who has ownership of this bill.

o Sandra Cook asked the members to be in close contact with he' Office of Legislation at all times regarding calls to or from the Hill. She and the Chairman expressed the concern that more coordination is needed in the Department on Hill matters and on Department matters.

3. Steven Kirsner discussed his paper "THE NCTM STANDARDS: A WELCOME VISION", which was written for inclusion in a forthcoming special issue of the School Science and Mathematics magazine. The paper is the Department's response to the National Council of Teachers of Math (NCTM) Standards. He will notify the Task Force Members when that issue is available.

4. John Childers discussed his proposal for the benefit of those who were not present at the February 16th meeting. The proposal is (1) to give visibility in carrying out the President's goals in math and science through volunteerism, and (2) to get individuals from various fields to volunteer under one of the issues. Larry Grayson said AAAS, NSF, NASA, and Energy all have a program similar to this proposal and the Department of Education needs something also.

o Genevieve Cornelius said scientists and mathematicians volunteer as teachers in Albúquerque. She mentioned an agreement with the Interior Department in this same area.

o The Chairman felt some attention needs to be made of coordination and cooperation among agencies. Larry Grayson suggested we communicate with other agencies as we begin our process, so the same poeple are not always contacted, the same questions not always asked, and so as not to make this process redundant.

o Karen Kelly suggested that we might consider calling an all-day meeting (Blue Ribbon) of various agencies that would discuss what their agencies are doing in the math and science area. The participants could move into small working groups where they would get additional information, encouragement and help, not just from the agencies and corporations, but from the outside individuals who would themselves be looking to these agencies for seed money. The participants could then come away with a proposal that all of government can use. This suggestion was made because it seems there are more than a few agencies that seem to be working on the same math and science issues, and perhaps we can be helpful to one another.

Donna Gerardi suggested the following agencies might be invited to participate in this meeting; Energy, NASA, NSF, Education, a few corporations and some interested individuals. If this meeting is possible, then we could find any overlap, the agencies and corporations could work more closely, and their staffs would now have a single point of contact with these agencies and corporations. She also said there is a great book out on this subject, Volunteers in Public School Departments put out by the Commission on Behavioral and Social Science and Education, of the National Research Council.

Barbara Rivers said the agencies and scientists need the Department of Education, as we need them, and we would welcome their assistance.

Milton Goldberg asked for comments or cautions on John Childers' proposal. Bill Wooten mentioned that the FIRST Office has a National School Volunteer Program and we might get some information from them.

The Chairman said we can submit John Childer's proposal to the Under Secretary from the Task Force, but before doing so we need to gather as much information as possible on existing efforts of this nature and recommendations.

5. The Chairman opened the discussion on the Inventory Entries by asking Conrad Katzenmeyer to say a few words on his meetings with Task Force Members and other staff regarding their process and procedure for gathering this information. Conrad Katzenmeyer discussed each of the POCs that have responded at this point. He said the documentation that exists differs greatly from Division to Division. The lack of documentation is especially severe for the bigger programs, such as Chapter 1 and Vocational Education.

Genevieve Cornelius said we need to look at data-base to collect information thoroughout the Department and that by December 1990, she expects to have a data-base in place with lists of OESE programs in Chapter 2 and also its grants in math and science. The Steering Committee for her program will meet on April 2nd and 3rd here in Washington, and she will find out if participants investment is cognitive with other investments.

The Chairman asked if the creation of a data-base, as suggested by the Task Force, would help program offices maintain their own files. One Member said his program barely has typewriters, let alone computers. Another said that (1) senior staff don't have time to input information in computers and if they did, their regular work would lag, and that (2) the support staff don't know how or just may do it wrong.

William Wooten says the Grants and Contracts people have codes to get into data-base that might be used with mathematics and science projects, how can we get one? The data-base could be used to categorize projects by subjects and subsections. Barbara Rivers said she would check on this to find out what are the requirements for it, and set up a meeting as soon as possible.

The Chairman asked Russell Aiuto what NSF did and is doing in this area that could he address. He said NSF has used data-base for a few years now. They have information logged by program and subject and are working on a further breakdown within each program area. Eddie Anderson said NASA can also track their grants in this manner. Donna Gerardi says she has used these documents from NSF and NASA quite frequently and found them extremely useful. If and when she needs information from this Department, she has to result to using our budget tables which are not as accurate as those from the other two agencies.

Conrad Katzenmeyer said at the next meeting he would like to have someone from the American Association for the Advancement of Science (AAAS) because he believes they do the best job in looking across agencies in math and science.

The Chairman said we need to spend more time on issues such as coordination, data-base, problem-solving, agency linkage, and we need to raise John Childers' proposal to the next level. We have until the end of June to prepare a report to the Under Secretary on the Task Force's findings on what the Department and other agencies are doing in the area of math and science. He said we would continue these discussions at our next meeting.

The Chairman adjourned the meeting at 11:20 A.M. and said he would be in touch regarding the date for their next meeting.

MATH AND SCIENCE PROGRAM SURVEY

GENERAL INSTRUCTIONS

We have revised the program survey instrument, incorporating the comments we received. The Task Force can now begin information collection. We want to begin with program data, whether for categorical or discretionary programs. By this we mean the information that refers to the overall effort. For example, for the Eisenhower State Program, we want to begin with the data about the federal effort that can be accumulated relatively quickly and easily-- the history of the program, how funds are distributed, on what basis, etc. At some level, programs usually fund projects, but we realize that project information will be more difficult to collect, if at all, under current operating plans.

There are three working principles we would like to use:

- The more information, the better. For the time being, we do not want to try to limit the amount of information collected. Selection can be done later, as necessary.

- We will not try to solve the problem of aggregation of information across programs at this point. The difficulty with trying to find common aggregation variables is that we are likely to have to settle for the lowest common denominators, those variables that may not tell much about any program in particular. This means that, for now, we are likely to be collecting more text than numbers. Lets see what we have and then move to more quantitative data. Of course, if you already have useful quantitative data, by all means include it.

- Where you have to make assumptions about what is or is not science or math, state your assumptions. For example, Vocational Education funds a number programs that are not strictly math and science, but do contain a good deal of math and science content. We will discuss these programs with you, but you are the best source of meaningful assumptions.

OUTLINE (Take the space necessary for each entry)

Program Name

Authorizing Legislation (give the actual language as well as legislation number if possible)

Significant changes that have occurred in the legislation, as appropriate

Current Program Funding level

Purpose

goals

beneficiaries

Description (types of activities supported e.g., equipment, curriculum, research, training, etc.)

Eligibility -- who may apply

Review process for determining awards

What are the steps in giving awards

Who has the discretion in making awards

Who and how many are impacted by the program

teachers

Children

LEAs

IHEs

Museums, etc.

Any other evaluation information available about impact

Collaboration and coordination within the Department or across agencies

PROJECT INFORMATION

For those of you who have information at the project level, we are also interested in starting to accumulate this now. Obvious examples are the National Eisenhower, where project descriptions have already been nicely packaged, the National R & D Center projects, the National Diffusion Network Projects (again, already packaged), and others. But others have these, as well. We will be particularly interested in getting printouts from Management Information Systems, where they exist, such as with bilingual projects. Please package these by program.

Project Title

Amount of award by year

Award Number

Duration (starting and ending dates)

Goals and intended beneficiaries

Description of activity (give enough detail to clearly describe what is being done. It can always be shortened later.)

Who and how many are impacted by project

Other evaluation information available on impact

Collaboration and coordination activities with other agencies

We assume that the program description that encompasses the project will include the information on how awards are made, who has the discretion, etc.

We recognize that no outline is going to be able to match the idiosyncracies of every program and project the Department has. Please give Con Katzenmeyer a call (357-6210) so we can set up a time to discuss your particular programs and projects.

APPENDIX F.

Table 4
U.S. Department of Education
Mathematics and Science Commitments
by Purpose

Categories*	FY 1990*		FY 1991*	
Precollege: Program Evaluation/ Assessment	14.0		8.5	
NCES	14.0	3	8.5	3
Precollege: Formal				
Curriculum/Materials Development	15.7		17.1	
Eisenhower (National)	8.8		9.2	
FIRST	1.5	1	1.5	1
Javits	2.2	2	2.2	2
Research & Development Centers	2.0	4	3.0	5
Research & Education of Handicapped	1.2		1.2	
Teacher Preparation/Enhancement	126.8		220.8	
Eisenhower (State)	126.8		220.8	
Direct Student Support	3.0		12.5	
Upward Bound-TRIO	3.0	20	12.5	20
Educational Technologies	13.3		5.2	
Fund for Innovation in Education	4.0	6	4.0	6
Star Schools	8.1	7	-	
Technology for the Handicapped	0.8		0.8	
Media and Captioning Service	0.4		0.4	
Comprehensive	1,863.1		1,998.8	
Bilingual	38.0	8	41.0	8
ESEA Chapter 1	1,148.3	9	1,239.7	9
ESEA Chapter 2	107.3	10	111.5	10
Indian Education	29.4	11	30.3	11
Magnet Schools (Desegregation)	28.1	12	28.3	12
Magnet Schools (Excellence-Proposed	-		25.0	13
Special Education--State Grants	231.0	14	242.0	14
Vocational Education	281.0	15	281.0	15
Dissemination/Technical Assistance	5.9		10.4	
ERIC	.7	16	.7	16
Regional Laboratories	3.0	17	7.5	17
National Diffusion Network	2.2	18	2.2	18
Undergraduate: Formal -- 4-Year: Formal				
Curriculum/Materials Development	2.9		2.9	
FIPSE	2.9	19	2.9	19
Direct Student Support	9.0		15.5	

Direct Student Support	9.0	15.5
National Science Scholars (Proposed)	-	5.0
McNair Post-Baccalaureate	0.2	0.2
Student Support Services	7.6	8.2
Minority Participation	1.2	2.1
Comprehensive	5.4	5.6
MSIP	5.4	5.6
Graduate		
Predoctoral Fellowships	24.3	34.8
National Needs	15.8	25.4
Patricia Roberts Harris	8.5	9.4
TOTAL	2,083.4	2,332.1

*Unless otherwise noted, entries are taken directly from the FY 1991 Department of Education Budget Request. Amounts in millions. Footnotes are listed to the right of budget entries and are futher explained on the attached sheet.

FOOTNOTES

1. Identified by specific project content in FY 1990 and FY 1991.

2. Identified by specific project content to be approximately 25% of total appropriation in FY 1990. Percent extended to subsequent years.

3. The National Center for Education Statistics total consists predominately of National Assessment of Educational Progress (NAEP) mathematics and science assessments, which can be precisely estimated; the balance is drawn from a number of surveys where the estimates are less precise.

4. Includes National Research Centers for Science, and for Technology plus individual projects in other Centers.

5. Includes National Research Centers for Mathematics, Science and Technology, plus individual projects in other Centers.

6. Computer and other technology projects dealing with mathematics and science identified for FY 1990 and FY 1991.

7. Identified by specific project content in FY 1990 to be approximately 55% of total appropriation.

8. Estimated at 20% of total appropriation.

9. Approximately 45% of participants of Chapter 1 participants recieve mathematics instruction, while approximately 70% receive reading instruction. Based on overlap of instruction and other, non-instructional services provided, it is estimated that 25% of appropriation supports mathematics instruction.

10. Approximately 30% of allocation of LEAs is estimated to be spent on mathematics and science.

11. Estimated at 40% of total appropriation.

12. Estimated at 25% of total appropriation.

13. Estimated at 25% of total appropriation.

14. Approximately 15% of allocation to States is estimated to be spent on mathematics and science.

15. Approximately 30% of total appropriation is estimated to be spent on mathematics.

16. The ERIC Clearinghouse on Mathematics, Science and Environmental Education represents half of this total. The balance is an estimate of mathematics and science activities across the other clearinghouses.

17. Mathematics, science, and technology projects estimated to be 16% in FY 1990 and 30% in FY 1991.

18. Identified by specific project content to be approximately 18% of total appropriation.

19. Identified by specific project content to be approximately 25% of total appropriation.

20. Estimate of science and mathematics percentage for total Upward Bound budget.

21. Estimated percentage of fellowships devoted to mathematics and science.

June 14, 1990

FCCSET WORKING GROUP ON THE FY 1992 EHR BUDGET PROPOSAL

Inventory of Federal FY 1990-91 EHR Activities

DEFINITIONS

Major Categorical Headings

Formal Programs: Programs designed for classroom instruction.

Informal Programs: Programs conducted in non-classroom settings that include broadcasting, museums, science clubs, and other community-centered activities which are designed to stimulate and maintain interest in science, mathematics, and technology. Include development of related preparatory guides and instructional programs that may be offered in a classroom setting.

Science: Science fields are to include mathematics, as well as behavioral, biological, computer, environmental, life, physical, and social sciences.

Minorities: Minorities include Blacks, Hispanics, American Indians, Alaskan Natives, and Native Pacific Islanders.

(Other) Technologies: Consists of study of technical, applied instruction (e.g., computer technology, engineering technology).

Program Elements

Program Assessment/Evaluation: Activities that include program evaluation; student assessment; data collection; research on the learning process; and projections of SET human resources supply/demand.

Curriculum/Materials Development: Programs that encourage use of recent advances in SET subject matter content (course and curriculum); support research in teaching and learning SET skills; equip students with knowledge and skills to handle problems from other disciplines; reduce barriers to participation in SET fields; and, lead to new or improved materials and strategies that support SET instruction, including print materials, computer software, video materials, laboratory equipment, etc.

Direct Student Support: Programs providing direct student financial assistance, e.g., fellowships, traineeships, scholarships, research assistantships, stipends, and cooperative education. Note that programs providing financial assistance to future SET educators should be categorized under teacher or faculty preparation/ enhancement.

Educational Technologies: Programs increasing the efficiency and effectiveness of SET instruction through the widespread use of advanced technologies, particularly the computer. Examples include innovative educational systems, interactive computer-videodisc systems, CD/ROM (compact disc, read only memory), intelligent tutors, authoring systems, problem-solving tools, and expert systems.

Comprehensive: Programs comprised of multiple elements (e.g., curriculum/materials development, teacher/faculty enhancement, administrative reform, community involvement,

formation of coalitions among institutions and between educational institutions and other sectors) which are designed to make systemic changes in the education delivery system and to increase both the number and quantity of students studying science, engineering, and (other) technologies (SET). Also include SET components of categorical, legislatively mandated programs (e.g., ED Chapter 1 programs for the disadvantaged, bilingual education, or magnet schools to effect desegregation).

Facilities: Programs providing direct support for construction and renovation of laboratory and classroom facilities used primarily for SET instruction. Please carefully document basis for budget numbers reported.

High School to Undergraduate, 2-Year to 4-Year Institution, and Undergraduate to Graduate Bridging Programs: Programs assisting in the transition from one education level/ institutional setting to another. Include academic, career awareness, and development programs.

Laboratory Improvement: Programs that generate effective and efficient approaches to laboratory and field-based instruction.

Teacher and Faculty Preparation: Pre-service programs that increase preparation for SET instruction. Do not include programs that are purely pedagogical in nature or that replicate courses normally available through graduate departments.

Teacher and Faculty Enhancement: In-service programs that enrich and strengthen the theoretical and practical bases for teaching the most up-to-date courses or provide experience with state-of-the-art laboratory equipment or provide incentives through the reward of excellence in SET instruction. Programs can include both content and pedagogy; but should not primarily enhance research ability; be purely pedagogical in nature; or replicate courses normally available in graduate departments. The term teacher refers to an educator at the precollege level; faculty refers to postsecondary level.

Fellowships (Pre- and Post-doctoral): Programs providing support to graduate students and postdoctoral fellows for research experiences in science and engineering.

Traineeships (Pre- and Post-doctoral): Awards made to institutions/departments providing funds for support of talented and deserving graduate students and postdoctoral trainees.

APPENDIX G.

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*****************************************************************************************
*  GCMS 01/13/89                                                          ANDUS130      *
*                              ABSTRACT DATA ENTRY/UPDATE                 ADD SCREEN    *
*  PR/AWARD Number : MRS9055001  MOD NUMBER: 0000   POC: OM     ITS     CFDA#: 000      *
*                                                                                       *
*  PROJECT/PROPOSAL TITLE: ********************************************                 *
*                          ********************************************                 *
*                          ********************************************                 *
*  ABSTRACT: ************************************************************************   *
*            ************************************************************************   *
*            ************************************************************************   *
*            ************************************************************************   *
*                                                                                       *
*  KEY WORDS: **************** **************** **************** ****************       *
*                                                                                       *
*  ACADEMIC FIELD: *** AREA OF EDUCATION: ***  ACTIVITY TYPE:  ** ** ** **               *
*  NSF CASE CODE : **  TARGET POPULATION: **   POPULATION BENEFITED:  ***********       *
*                                                                                       *
*  ENTER=Validate, PF1=ADD Record, PF3=Display Tables, PF16=Exit                        *
*                                                                                       *
*****************************************************************************************
```

The abstract screen is broken down into five areas: (1) project title, (2) abstract, (3) keyword descriptors, (4) descriptor codes, and (5) estimate of population benefited. A description of all five areas follows:

(1) Project/Proposal Title - Descriptive title of the project

(2) Abstract - The abstract is a more detailed description of the project than the title and includes the goals and resulting products. Depending on the project, the abstract could be brief or more extensive. For example, the Department's copy center contract could be described in a sentence:

> "Contract to provide 10 centers to handle departmental xeroxing requirements."

Another contract, for example, one for technical assistance centers for special education would need to be more descriptive because of the range of activities involved:

> "Contract for 6 regional centers to provide technical assistance to school districts with severely handicapped students. The centers will also survey the needs of severely handicapped students in their regions and provide yearly reports to the Department. The centers will develop position papers for the Department and the special education community on topics selected by the Department."

Where to get started creating an abstract? Many grants have an overview in the grant proposal that would be descriptive enough of the activities and outcomes to serve as an abstract. For contracts, the background and introductory section of the statement of work or block 15 in the award document might serve as an abstract as well. In both cases, you may need to expand the overview to cover any areas of the project that were not mentioned.

(3) Keywords - These are one word descriptors of the subject area or activities of the project.

The list of keywords is attached to these materials and can also be reviewed on the screen by selecting the display tables option (PF3) at the bottom of the data entry screen, and then selecting the appropriate table from the table selection screen. When deciding on keywords, look for words in the abstract that are on the keyword list or for words related to those on the list. Since most projects touch on many different areas, several keywords will usually be required to adequately identify a project. These keywords are very valuable for users researching the database for general areas of activity. The keyword list is not fixed and it will have words added to it from time to time as the

Department's activities and program initiatives change. As an example of choosing keywords, assume we have a contract evaluating computer use by handicapped elementary students. We could use the following keywords to identify it: handicapped, elementary, computers, child.

(4) Descriptor codes - Descriptor codes identify the subject area of the project to assist with searching the database. There are five descriptors: Academic Field, Area of Education, Activity Type, National Science Foundation (NSF) Case Code, and Target Population.

The lists of code values are attached to this material and are also reviewable on the screen by selecting the display table option (PF3) on the data entry screen, and then selecting the appropriate table. When selecting a code value, pick the one that best describes the project. In cases where several descriptor codes apply, pick the one that describes how the largest amount of funds are being used. The National Science Foundation Case Codes apply to only certain projects. Unless you are certain it applies to your project, use the code 09 (not applicable to this program/project code).

(5) Population Benefited - This is the estimated number of persons who will benefit from the project. Just enter the number of persons, there is no table for this item.

Each area on the abstract data entry screen should be completed for each award: title, abstract, keywords, all descriptor codes, and population benefited. When the data entry screen is completed, press PF1 to add the information to the system. (The next three pages show the lists of descriptor codes and keywords.)

ACADEMIC FIELD TABLE

Code	Translation
BRM	Basic Skills in Reading and Math
BUA	Business Administration
COG	Counseling and Guidance
COS	Computer Science
DRA	Drug and Alcohol Abuse
ENG	Engineering
FOL	Foreign Language (not English)
HUM	Humanities
LAW	Law
MAT	Math
MED	Medicine
NAR	Natural Resources
OTH	Other
PSY	Psychology
SCI	Science
SED	Special Education
WOC	Written/Oral Communication

AREA OF EDUCATION TABLE

Code	Translation
BIE	Bilingual Education
COE	Compensatory Education (Migrant Ed, Chptr 1, etc.)
COM	Computer
DAA	Drug and Alcohol Abuse
DES	Desegregation
GEE	General Education
INT	International
REH	Rehabilitation
SPE	Special Education
SSC	Social Studies/Civics
VOT	Vocational/Technical

KEY WORD TABLE (in alphabetical order)

ABROAD	ADULT	ADVISORY	AIDS	ALCOHOL
ARTS	AUDIOVISUAL	AUSTRALIA	BARBADOS	BILINGUAL
BLACK COLLEGE	BLIND	BUSINESS	CANADA	CAPACITY
CAPTIONED FILMS	CAREER	CENTER	CHARACTER	CHILD
CHILDHOOD	CHILDREN	CHOICE	CIVIL RIGHTS	CLINICAL
COLLEGE	COMMUNICATION	COMPREHENSIVE	COMPUTER	CONSTRUCTION
CONSUMER	CONTENT	COUNCIL	CRIPPLED	CULTURAL
DEAF	DEAF-BLIND	DELINQUENT	DEMONSTRATION	DENMARK
DEPRIVED	DESEGREGATION	DEVELOPMENT	DISABILITIES	DISABLED
DISADVANTAGED	DISSEMINATION	DROPOUTS	DRUG ABUSE	DRUG-FREE
DRUGS	DYSLEXIA	EARLY EDUCATION	EAST GERMANY	ECONOMIC
ELEMENTARY	ENDOWMENT	ENGINEERING	ENGLISH	ENTITLEMENT
ETHNIC	EVALUATION	FAMILY	FEDERAL	FELLOWS
FELLOWSHIP	FIELD INITIATED	FINANCIAL	FORMULA	GENDER
GIRLS	GRADUATE	HANDICAPPED	HAWAIIAN	HBCU
HISTORY	HUMANITIES	IHE	ILLITERACY	IMMIGRANT
INDEPENDENT	INDIAN	INDUSTRY	INFANT	INNOVATION
INNOVATIVE	INSERVICE	INSTITUTIONS	INTERNATIONAL	INTERPRETORS
K-12	K-8	LABORATORY	LAW	LEA
LEADERSHIP	LEGAL	LIBRARIANSHIP	LIBRARY	LITERACY
LITERATURE	LOW-INCOME	MAGNET	MAINSTREAMING	MATHEMATICS
MEDIA	MEDICAL	MENTAL	MENTALLY	MIGRANT
MIGRATORY	MINORITY	MODEL	NATIONAL	NATIONAL ORIGIN
NATL ASSESSMENT	NEGLECTED	NONPROFIT	NONPUBLIC	OCCUPATIONS
OPPORTUNITIES	ORGANIZATIONS	OUTREACH	PARENTS	PERSONNEL
PHYSICAL	PHYSICALLY	POPULATIONS	POSTSECONDARY	PREPARATION
PRESCHOOL	PRIVATE	PROFICIENCY	PUBLIC	RACE
RACIAL	READING	RECREATION	REFUGEE	REGIONAL
REHABILITATION	REHABILITATIVE	RESEARCH	RESERVATION	RURAL
SCHOOL	SCHOOL DISTRICT	SCIENCE	SEA	SECONDARY
SERVICES	SEVERELY HANDI	SEX	SPEAKING	SPECIAL EDUC
SPINAL CORD	STATE	STRENGTHENING	STUDENT	STUDIES
SYNTHESIS	SYSTEM	TEACHER	TEACHING	TECHNICAL
TECHNOLOGY	TRAINING	TRANSITION	TRIBE	UNDERGRADUATE
UNDERSERVED	UNIVERSITY	URBAN	VOCATIONAL	VOLUNTARY
WOMEN	YOUTH			

COORDINATION OF PROGRAMS ON MATHEMATICS AND SCIENCE EDUCATION FOR THE DEPARTMENT OF EDUCATION, THE NATIONAL SCIENCE FOUNDATION, AND OTHER AGENCIES

This report responds to language in the House of Representatives and the Senate Labor, Health and Human Services, and Education Appropriations Subcommittees' reports on the FY 1990 appropriation regarding mathematics and science education programs administered by the Department of Education (ED). The House Committee requested a report that would detail "efforts to coordinate math and science programs with those of the National Science Foundation (NSF)." The Senate requested a report, "which reviews the present efforts of the Department to coordinate its activities in the areas of math and science education with other Federal agencies, particularly the NSF, and a strategy to enhance such coordination in the future."

The report is organized into three sections. The first section describes the collaborative efforts that are currently underway. The second section discusses the history of ED's science and mathematics education collaboration, with special emphasis on the collaborative efforts with NSF. The final section presents some topic areas and programs that have potential for future agency collaboration.

CURRENT COLLABORATIVE EFFORTS

The issue of collaboration regarding math and science education has received considerable attention this past year, which has led to establishment of some highly significant structures and relationships in the past several months. Perhaps the most significant step has been the formation of an Education and Human Resources Committee under the Federal Coordinating Council for Science, Engineering, and Technology FCCSET). The President's Science Advisor, Dr. Bromley, has appointed Secretary of Energy Watkins as Chair, with the Under Secretary of Education and the Senior Science Advisor of NSF as Vice Chairs. This Committee will encourage and coordinate Federal programs and policies related to science, mathematics, engineering, and technological education, training, and human resource development.

In addition to the FCCSET Committee, the Secretary of Education and the Director of the NSF have established formal mechanisms for coordination of mathematics and science education programs between the two agencies. The Director of NSF appointed his Senior Science Advisor (Luther S. Williams) to chair NSF's coordination effort. The Assistant Secretary for Educational Research and Improvement (Christopher T. Cross) has been charged with the coordination effort for ED. Coordination at all appropriate levels between ED and NSF is the continuing responsibility of these high-level officials. These new coordination efforts replace earlier ad hoc coordination arrangements.

Collaboration of the two agencies under this mechanism has already reached beyond coordination to the development of cooperative initiatives and relationships. Areas in which agreements to collaborate (subject to receipt of positive peer reviews) include:

- Joint funding of the American Association for the Advancement of Science "2061" Phase II curriculum development projects. These projects are designed to develop alternative curricular strategies to achieve the learning goals described in the AAAS/Project 2061 report "Science for All Americans."

- Joint funding of core support for the National Academy of Science's Mathematical Sciences Education Board. MSEB was created with the full backing of the mathematics and mathematics education community to encourage the reform of mathematics education throughout the country. Its report "Everybody Counts" lays out a broad strategy for change that will be national in scope. A senior ED official served on the committee reviewing the MSEB proposal.

- Joint funding of educational television programs.

In addition to these joint funding efforts, agreements have been reached on the following means to enhance collaboration.

- NSF is developing appropriate protocols for their materials and exemplary teacher professional development projects so that they can be shared through the Department's dissemination networks, such as the National Diffusion Network, regional laboratories, and technical assistance centers.

- The Department's Eisenhower Science and Mathematics Education programs at the State and local levels will continue to support teacher participation in NSF teacher enhancement projects.

- The Department plans to implement a new mathematics and science initiative under the Upward Bound programs. Plans for this initiative are being coordinated with NSF and the National Programs component of the Eisenhower Mathematics and Science Education program.

- State and local education agencies making application to NSF for support under the systemic reform program are being encouraged to use Eisenhower Act, Chapters 1 and 2, and Vocational Education funds to strengthen science and mathematics learning initiatives.

The Department of Education has also taken internal steps to foster collaboration and coordination. The Department has established a Task Force on Mathematics and Science Education, chaired by the Director of the Office of Research, that includes all operating units within the Department. The Task Force's task is to compile a comprehensive compendium of Department science and mathematics activities that will provide the information necessary to increase coordination with other agencies. This report is due June 30, 1990. The Task Force will also be exploring means of improving coordination with other agencies. In addition to all of the Department's offices, NSF and members of OSTP, Energy, NASA, NAS, and other agency staff meet with the Task Force.

HISTORY OF COLLABORATION

Background

The Department of Education and the National Science Foundation share a deep concern for the improvement of science and mathematics education in this country and each has pursued a mission to carry this out. At times the two agencies have supported similar activities, while at other times the efforts have been complementary. Both NSF and the U.S. Department of Education have supported major curriculum development. NSF's science projects, such as Biological Sciences Curriculum Study, Science Curriculum Improvement System, and Science: A Process

Approach are justifiably renowned. Education's math projects, such as Comprehensive School Mathematics Program and Developing Mathematical Processes, are also held in the highest regard in the mathematics and science education communities. Both agencies have also supported research on teaching and learning processes for mathematics and science. For example, NSF funded the research on teacher "wait-time," while Education was responsible for the research on student misconceptions in science. Such projects are examples of a healthy, multi-faceted R&D system searching for the best ideas wherever they might be found.

Limited resources also require that redundancies and duplication across agencies be kept to a minimum. While there has never been an official division of responsibilities between the agencies, there have been attempts to establish such distinctions. When the Department of Education was created in 1979, an effort was made to carefully distinguish efforts of the two agencies. This resulted in the transfer from NSF to the Department of Education of the Minority Science Improvement Program and the equivalent of the elementary education portion of the Teacher Institutes Program.

There are differences in both the missions and procedures of Education and NSF. However, most of these should be seen as differences in emphasis rather than categorical distinctions.

MISSION DIFFERENCES

1. o NSF was established to promote and advance mathematics and science (which includes engineering, technology and the social sciences). In any joint funding ventures focusing on broad topics, NSF can support only that portion addressing these disciplines.

   o The Department of Education was established to guarantee that students have equal access to the best possible education and to improve the quality of education for all students.

2. o Because of the pre-doctoral fellowship program and the research assistantships and associateships supported by research grants, NSF has a major presence in graduate education and postdoctoral education.

   o Because of the large, formula grant programs addressing K-12 concerns and its student financial assistance programs, the Department has been more identified with pre-college and undergraduate education.

PROCEDURAL DIFFERENCES

1. o NSF's funds are all discretionary. Substantive directions are determined at the national level, under the guidance of peer review.

   o The Department's funds are predominately distributed by formula. Procedures are set at the national level, but substance is often determined locally.

2. o Traditionally, NSF has dealt with mathematicians, scientists, and math and science educators directly, to the extent possible.

- The Department has more frequently dealt with state and local education agencies and institutions of higher education.

  As an example, NSF sends reviewers' comments on research proposals directly to the Principal Investigator, while the Department routinely returns them to the institutional representative, who is in the institution's research office in many higher education institutions.

3. - In higher education, NSF's contacts are primarily with individuals in math and science departments.

   - The Department's contacts in higher education are more likely to be with college administrators, and with colleges of arts and sciences and education.

4. - NSF grants all of its awards "up front." A three-year award is granted completely from the current year's appropriation. Since each year's appropriation represents uncommitted funds, a major share of agency activity must be devoted to the processing and peer reviewing of proposals to commit those funds.

   - The Department usually funds in one-year increments, even for multi-year awards. Any year's appropriation is already substantially committed to continuations. A major share of agency activity must be spent on monitoring awards for continuation.

5. - In supporting project development, NSF puts strong emphasis on monitoring early, conceptual activities. Ensuring that projects contain "good science" is a central theme.

   - The Department is more likely to emphasize impact and use of any project it supports. Thus, outcome evaluations and dissemination have been topics of major concern for many years.

Previous Coordination Efforts

There are two different ways in which coordination occurs between the Department of Education and other agencies, particularly NSF -- communication and mutual planning, and joint funding. Although joint funding is a more visible sign of collaboration, it occurs through the many regular contacts between the agencies, particularly those at the program level.

A. Communication and Mutual Planning

Coordination and collaboration with other agencies, particularly NSF, have been occurring for many years. When the National Institute of Education was established in 1972, it had a designated science advisor who came from the staff of NSF. Cooperation with NSF has continued with the Department of Education.

The most obvious examples of current communication and mutual planning have occurred in relation to the Eisenhower Mathematics and Science Education Program. Department staff in the Office of Elementary and Secondary Education (OESE) administering the

State Grants program have secured input and advice from the National Science Foundation, the Department of Energy, NASA, and other Federal agencies. NSF, DOE and NASA are represented on the National Steering Committee that Education has established to help give direction to the Eisenhower Program.

Other forms of communication have also been developed. For example, at the most recent Annual National Conference of the Eisenhower State Coordinators, NSF staff set up an exhibit, distributed documents, and were responsible for about a half-day of the conference program. OESE staff participate in NSF-sponsored conferences and review applications to NSF for programs of national significance.

For postsecondary education, regular communication occurs between Education and other agencies. Regarding the Minority Science Improvement Program, there is an informal task group involving NSF and several other agencies that meets to share information on support for science and technology. There are also regular informal discussions between Education and NSF regarding the Fund for the Improvement of Postsecondary Education, specifically on faculty development projects addressing math and science. This matches with NSF's initiative in faculty development.

For research, dissemination, and statistics, there are many instances of communication and mutual planning. Under Secretary Sanders spoke at NSF's Science and Engineering Education Directorate's Advisory Board meeting. Staff members of Education and NSF regularly serve as reviewers for one another's projects. Specific instances of collaboration between Education and NSF are also detailed in the following section.

B. Joint Funding

A long-standing relationship exists between the National Science Foundation and the U.S. Department of Education. The nature of this relationship has changed as the common interests of the agencies have evolved.
NSF and the Department of Education have cooperated on a number of projects. For example, in 1977 NSF and the National Institute of Education jointly supported a competition that brought together natural scientists and cognitive psychologists for some of the early research on the cognitive structure of learning and instruction. Results of this research are now having major impacts in the classroom.

Among the most recognized examples of cooperation between Education and NSF are their joint funding of the following television series. These highly praised educational programs have been viewed by millions of children.

- Square One TV - A television series to supplement classroom mathematics education for children 8-12 years of age.
- 3-2-1 Contact - An Emmy-award winning children's science television series.
- Voyage of the Mimi - An integrated math, science, and technology program for the upper elementary grades.

Many of the recent joint funding efforts have occurred between the NSF and the National Center for Education Statistics. Because of the intense interest in reform and accountability, data collection aimed at illuminating the status of science and mathematics education at the national level has provided many opportunities for mutually beneficial projects.

1. Analysis of National Education Longitudinal Studies Data

   NCES co-funded with the NSF analytic studies on: 1) Systemic Analysis of School and Community; 2) Student Engagement in Learning; 3) Student Subcultures; 4) Outcomes for Low Performing Students; and 5) NELS:88 Research Information Management System. (Dollar figures represent Department of Education contribution).

   Funding: FY 1989 - $300,000
   FY 1990 - 142,000

2. ASA/NCES/NSF Research Fellows Program

   NCES augmented the NSF grant to the American Statistical Association to bring academic statisticians to NCES to conduct research studies using NCES data bases.

   Funding: FY 1989 - $40,000

3. Second International Science Study (IEA)

   NCES joined NSF to support Columbia University's conduct of an analysis of the Second International Science Study.

   Funding: FY 1988 - $ 40,000
   FY 1989 - $ 100,000

4. International Assessment

   NCES and NSF supported the Educational Testing Service's (ETS) conduct of a comparative study of mathematics and science achievement of 13-year-olds in five countries: Korea, the United Kingdom, Spain, Canada (three provinces-Quebec, Ontario, New Brunswick), and the United States.

   Funding: FY 1988 - $150,000
   FY 1989 - 170,547

5. International Assessment

   NCES and NSF jointly funded ETS' conduct of a second international assessment of the mathematics and science achievement of 13-year-olds in 20 countries. Most countries will participate in an optional geography probe and about two-thirds will participate in an experimental performance assessment of 13-year-olds. Additionally, an assessment of 9-year-olds in mathematics and science will be implemented by about two-thirds of the participants.

   Funding: FY 1990 - $250,000

6. Annual Survey of Earned Doctorates

   NSF joined NCES in the collection of data on earned doctorates in all disciplines.

   Funding: FY 1989 - $156,000
   FY 1990 - 156,000

7. Board on International Education Studies

   NCES and NSF are providing support to the National Academy of Sciences (NAS) to develop specific recommendations for a permanent international framework to coordinate international assessments that would compare the performance of U.S. students in mathematics and science to that of their counterparts in other industralized nations.

Funding: FY 1988 - $75,000
FY 1989 - 85,000
FY 1990 - 75,000

8. State-Based Network to Develop Science and Mathematics Indicators

NCES and NSF jointly funded the Council of Chief State School Officers to develop a Teacher Supply and Demand Model in seven northeastern states.

Funding: FY 1989 - $ 66,000
FY 1990 - 161,140

9. Committee on National Statistics

NCES is one of the several Federal agencies that support the core activities of the Committee on National Statistics of the National Academy of Sciences. The National Science Foundation coordinates the activities of the Committee.

Funding: FY 1989 - $75,000
FY 1990 - 30,000

10. National Education Longitudinal Study of the Eighth Grade Class of 1988 (NELS:88)

NSF augments NCES' Teacher Supplement to the NELS:88 to collect information on math and science teachers.

Funding: FY 1986 - $115,000
FY 1987 - 175,000
FY 1988 - 175,000
FY 1989 - -0-
FY 1990 - 499,954

The Office of Research and NSF also jointly funded an analysis of transcripts of college students to determine the amount of science and mathematics coursework that they had taken. The specific task in this study was to develop a viable taxonomy of course categories in science and engineering fields.

There are also some less direct but nonetheless important ways in which the two agencies have cooperated on joint funding. A number of curriculum projects developed under NSF support are now being disseminated through Education's National Diffusion Network. This provides a means through which promising programs can be disseminated to a broader audience, and provides for leveraging of NSF's substantial initial investment in these projects. Life-Lab, Mechanical Universe, Sci-Math, and Informal Science Study are examples of NSF-originated projects that have become part of NDN. Similarly, NSF has supported regional teacher training programs that have drawn upon these and other NDN projects.

NSF has also funded a number of projects in the national R&D Centers that the Office of Research supports.

- The Center for the Study of Learning at the University of Pittsburgh, in conjunction with the American Federation of Teachers, is synthesizing new knowledge on mathematics learning and instruction, transforming this knowledge into practical materials, and disseminating these to the field.

- The Center for Policy Research in Education at Rutgers University is studying the content of mathematics and

science courses that high school students are taking as a result of education reform. This is an extension of earlier work that found students' course taking has increased, but that usually these courses cover rudimentary math and science.

- The National Center for Research in Mathematical Sciences Education at the University of Wisconsin-Madison and the National Center for Improving Science Education at the Network, Inc. are also examples of efforts funded by both NSF and ED. Much of the research being conducted at the math center is based on a model for research and curriculum development called "Cognitively Guided Instruction" developed by Fennema, Carpenter, and Peterson with funding from NSF. Likewise, the science center is partly an outgrowth of a study on the dissemination of science curricula carried out by the science center for NSF.

TOPICS FOR POSSIBLE FUTURE COORDINATION

As discussions proceed between the Department of Education, NSF, and other agencies, there are other areas in which collaboration might occur. Following is a list of topics that have promise for joint efforts.

A. USE OF U.S. DEPARTMENT OF EDUCATION DISSEMINATION NETWORKS TO PUBLICIZE PROJECTS; AND THE RESULTS OF JOINTLY SUPPORTED ED-NSF PROJECTS.

The following are examples of Department of Education networks that could be used to disseminate information on NSF-funded materials development projects and resulting materials.

Office of Educational Research & Improvement (OERI):

The Urban Superintendents' Network

OERI, through its Programs for Improvement of Practice, supports a network of urban superintendents of schools--the network can serve as an important conduit of information to large inner-city school systems.

National Diffusion Network (NDN)

The NDN is organized to disseminate promising curricula in all school subjects; a significant portion of these projects concerns mathematics, science, and technology. Currently NSF has funded the COSMOS Corp. to identify "well-documented" exemplary NSF-supported projects. This effort could be expanded to include promising materials development projects that have been field-tested in schools and school systems.

Regional Education Laboratories

The nine regional labs supported by OERI are designed to provide technical assistance to States and local education agencies. Many conduct workshops, issue publications, or provide technical assistance to improve instruction in mathematics and science. The Labs could be encouraged to expand their math and science efforts and to emphasize NSF-

Eisenhower National Programs

The Eisenhower Act National program conducts meetings of Eisenhower State mathematics and science coordinators and Eisenhower National Programs project directors. These meetings could be co-sponsored by ED and NSF to join together in making innovative materials, innovative learning technologies, exemplary practice, and salient research available to participants.

The Education Resources Information Center (ERIC)

ERIC is a national system of clearinghouses that share research results and exemplary practices through publication references and special reports. Most clearinghouses provide information relevant to mathematics, science, and technology education; however, the Clearinghouse for Science, Mathematics, and Environmental Education (Ohio State University) focuses explicitly on these areas. This Clearinghouse works with over 30 national associations and more than 200 Federal, State, and local school agencies and organizations. All of the Clearinghouses could be encouraged to prepare syntheses and publications on mathematics, science, and technology relative to their missions that draw on NSF generated research and materials.

Office of Elementary and Secondary Education (OESE)

CHAPTER 1

Much of Chapter 1 funding supports mathematics instruction. State and local administrators are familiar with a variety of effective instructional programs in mathematics, science, and technology. Chapter 1 projects frequently are part of networks of administrators, parents, and teachers. These groups could be important conduits of knowledge about exemplary practice and innovative materials, such as from NSF-funded projects.

EISENHOWER STATE GRANTS PROGRAM

Grants to local school systems and to institutions of higher education to work in partnership with local schools and teachers could include a documentation and dissemination component focused on exemplary programs and the use of technology.

Office of Vocational and Adult Education (OVAE)

NCRVE

The National Center for Research on Vocational Education (NCRVE) at the University of California-Berkeley has a significant dissemination responsibility that could include NSF-supported efforts.

B. R&D ON EFFECTIVE LEARNING, TEACHING, SCHOOL ORGANIZATION, AND POLICY; AND THE USE OF TECHNOLOGY FOR LEARNING AND TEACHING IN SCIENCE, MATHEMATICS, AND TECHNICAL EDUCATION

OERI

National Research and Development Centers

Many of the 26 Research and Development Centers supported by the Department's Office of Research (in OERI) focus on issues that are important to mathematics, science, and technology education. The following Centers place special emphasis on these areas:

- The National Center for Research in Mathematical Sciences Education (The University of Wisconsin-Madison)
- The National Center for Improving Science Education (The Network, Inc., Andover, Massachusetts)
- The Center for Technology in Education (Bank Street College of Education in New York City)
- The Center for the Study of Learning (The University of Pittsburgh)
- The Center for the Learning and Teaching of Elementary Subjects (Michigan State University)
- The National Center for Research on Teacher Education (Michigan State University)
- The Center for Policy Research in Education (Rutgers University, with partners at Stanford University, Michigan State University, and the University of Wisconsin-Madison)
- The Center for Research on the Context of Secondary School Teaching (Stanford University with partners at Michigan State University and the Rand Corporation)

The two agencies are currently discussing the funding of a project on mathematics education reform to be conducted by an existing center. In addition, NSF is considering the possibility of jointly funding and monitoring new centers in mathematics and science that are presently being competed and will begin operation in FY 1991.

The current collaboration between NSF and ED that contributes to the R&D programs of these Centers can be expanded and made more formal. ED will provide NSF with the technical proposals of these Centers so that NSF can help identify promising new areas for collaboration.

ED will provide NSF with information from programs such as the Fund for Innovation in Education (FIE) and the Vocational Education Technology Education Program, and NSF will likewise keep ED abreast of relevant programs.

C. ENHANCED ASSESSMENTS OF STUDENT ACHIEVEMENT

OERI

National Center for Education Statistics (NCES) administers the National Assessment of Educational Progress

One of the most important post-summit activities relating to the national education goals will be the development of appropriate national and international comparative assessments of student learning in science, mathematics, and related technical education. NSF and ED/NCES already have a strong track record of collaboration in national and international assessments. A major future activity will be to coordinate the needed research, experimentation, and trials of appropriate performance assessments, such as portfolios and related assessments, which measure authentic acquisition of knowledge, habits of mind, and skills related to science and mathematics.

Office of Research

The National Center for Research on Assessment, Testing, and Evaluation, the National Center for Research in Mathematical Sciences Education, the National Center for Improving Science Education, and a number of other Centers will have significant assessment projects. Details of these Centers' assessment-related projects will be provided to NSF to identify promising areas of collaboration. As discussed previously, possible collaboration activities involving new centers are being discussed with NSF.

D. PROGRAMS WITH STATES

ED will alert its State networks, such as the Eisenhower State coordinators, the NDN State facilitators, and the vocational education regional curriculum coordinators, that NSF is initiating a State network program. Our network facilitators will be asked to cooperate.

E. PROGRAMS FOR URBAN EDUCATION

Each of the following programs could be given incentives or strongly encouraged to work in collaboration with urban school districts engaged in comprehensive, systemic education reforms focused on science, mathematics, and technological education--with a particular emphasis on underrepresented groups. These efforts are suitable for collaboration with NSF.

OERI

Office of Research

National Center on Education in the Inner Cities
National Center on Effective Schooling for the Disadvantaged
National Center on School Organization and Restructuring

Urban Superintendent's Network
LEAD Leadership Training Centers and State Leadership Training Programs
Principal Training (proposed)

OESE

Chapter I
Magnet Schools in Desegregating Districts
Magnet Schools of Excellence

F. PROGRAMS TO IMPROVE COORDINATION IN THE AREA OF POSTSECONDARY EDUCATION IN SCIENCE AND MATHEMATICS, INCLUDING THE PREPARATION OF TEACHERS

Both ED and NSF have substantial involvement in programs intended to strengthen the mathematics and science skills of postsecondary students, including prospective teachers. The following programs will be encouraged to work closely with NSF as they plan and carry out their work.

OERI

Office of Research

- National Center for Research to Improve Postsecondary Teaching and Learning, University of Michigan, Ann Arbor
- National Center for Research on Teacher Education, Michigan State University, East Lansing

Office of Postsecondary Education

- Minority Science Improvement Program (MSIP)

  Support for minority institutions, including Historically Black Colleges and Universities and other institutions whose enrollments are composed predominantly of underrepresented minorities, is a common goal of ED and NSF. Strong coordination between MSIP, which focuses on support for research skills among faculty and upper level undergraduate students, and the NSF research programs could be developed.

- Fund for the Improvement of Postsecondary Education (FIPSE)

  FIPSE supports projects in the development of teachers and teacher education. Stronger coordination and jointly funded projects or competitions could be developed with the NSF teacher preparation program.

  FIPSE also supports faculty and curriculum development projects that could be coordinated with NSF Instructional Laboratory Improvement projects, faculty enhancement and curriculum development projects.

- OPE supports graduate fellowships whose national priorities include the physical sciences and engineering. A closer working relationship between OPE and NSF's Division of Research Career Development could be established.

Senator MIKULSKI. We are now going to move to our questions. We thank the panel for their excellent testimony and the issues they have laid out.

Sometimes when we talk in programmatic terms we lost sight of the issues. But I know that we are going to get to them. I think all the panelists know of my very keen interest in the issue of coordination and the fact that we need to use our money smarter.

We thank you for the preview of the FCCSET Committee and the direction being provided by Admiral Watkins in chairing that Committee. I will come back maybe in my second round for questions on that.

But I would really like to speak from the standpoint of what it is like out in the neighborhood, what is out in the small town, what is the perspective of where we are in the area of teachers, and then also what is this relationship to parents?

The first teacher that a child has is his or her mom and dad. So then how does this linkage occur?

TEACHERS

Well, let us go to the issues of teachers and then my questions. First of all, in the area of teachers, we know that we need a million by the year 2000. We need to recruit them, retain them, and retool them, essentially bring them into the skills that they need.

This then takes me to my questions in that particular area. When I was at the Challenger Center in Prince George's County watching boys and girls doing hands-on science projects—wonderful, wonderful experiences—I was talking to the elementary school teachers who were with the kids. They then said to me they loved it. They had not had biology since they had been at Towson State in 1965, and they were learning pH's, and I do not mean Ph.D.'s. They were learning pH's and weather and et cetera.

My question is, how can we focus and what is the nature of your programs on retooling them, and how would that work?

I note, Mr. Bloch, in your testimony, what National Science Foundation is doing. I know this is an important area that the Watkins committee and his initiatives out of the DOE laboratories are doing.

So here is my question: What are we doing to retool the teachers and how are we getting the information out to the 16,000 school districts?

Let me give you another example and then I will turn it over to you. I was talking to one of my teachers in Broadway Market, the ethnic market in my neighborhood, and she was taking her kids on a trip to one of our rivers in Maryland. We were going to have first graders out doing laboratory experiments as part of Earth Day and then she was going to keep it up.

LACK OF SPECIAL MATERIALS

I said, "Have you gotten the special materials from the National Science Foundation? It is Science Week." She said: "What?" Energetic teacher, innovative on her own, no lethargy there, no clinging to stereotypical approaches to education. But she had not received it.

I traced it a bit in Baltimore County, because she is with a suburban school district, not Baltimore City. And what we find is it just has not gotten out.

So I want to know, first of all, What are we doing to retool the teachers? When you develop these excellent materials, how do they get out to the 16,000 school districts and down to the teacher level?

There are 250,000 science teachers in this country. I understand we are reaching 5 percent or less than 12,500. Hey, I believe we should mine where there is gold, as long as it is not in South Africa, and drill where there is oil, as long as it is not offshore coastal. I think our best resources are where we find it.

So having this rather bland question, I would like to see what you have to say on that.

Mr. Bloch, let's start with you, then we go to the Department of Education, and then see how the others might respond to that question.

RETOOLING TEACHERS

Mr. BLOCH. Well, Madam Chair, you asked a number of questions. You asked about retooling teachers, and let me just add another one: initial tooling of teachers. Then you asked about dissemination of materials. I want to talk about both of these aspects.

One of the big activities in our precollege programs has to do with teacher preparation. In fact, about three-fifths of our total program is devoted to that particular effort, where we are taking teachers during summer months or during the school year and bringing them together for an updating.

But let me point out also that many of our programs in the undergraduate education area—and I mentioned that that one covers 2-year colleges and not only 4-year colleges——

Senator MIKULSKI. Excellent.

Mr. BLOCH [continuing]. Are really there to train and educate teachers originally in many of these areas, like mathematics, physics, biology that you mentioned, and so forth.

So I think there are two aspects. We have the training of the teachers originally and then the continuous updating of the teachers while they are in service. We have also put programs in place that link up these teachers whom we have together for a while when they go back and have established networks that will allow them over a long period of time to be in contact with and learn from each other.

With regard to dissemination of materials, that is a very important aspect. Again, like in everything else, it is not just one particular activity that you can be satisfied with; it is a number of things.

For instance, every year we publish a directory of awards with the names of the individuals who have received awards.

Second, many of our programs have built-in dissemination criteria and activities. I mentioned in my oral statement that we have an initiative built into one of our programs, the middle school program, that essentially has the participation of the publishers right from the beginning, and there is a dissemination source essentially.

We have activities underway, and we have really focused on these due to the interest of Dr. Bromley, together with the Department of Education to use their dissemination network.

MATERIALS NOT DISTRIBUTED

Senator MIKULSKI. Mr. Bloch, excuse me. I know that you have all that. But then when I check with the teachers, they do not get the materials. That is my whole point.

We can develop all the wonderful materials, and I have looked at those materials and found them to be superb. But then they are not out in the hands of classroom teachers. What are we doing about that? Now, I am going to turn to you, Mr. Cross.

Mr. BLOCH. Can I just say one thing? one example? It is not for lack of trying. The material that we prepared for National Science Week, for instance, we got out through these publications and hit a lot of teachers.

Senator MIKULSKI. Well, see, I do not know if it is inertia at State bureaucracies, where everybody is more interested in memos than in getting the material out. I know we have a problem. Even in Baltimore City, we had textbooks sitting in a warehouse and it required the personal attention of Mayor Schmoke to get them distributed.

That illustrates the question. We spend money and we do not get the product into the teachers' hands.

Mr. Cross, do you want to comment on that? Sixteen thousand school districts. What happens when NSF develops materials? Do you all meet? Do you have a sense of urgency?

NATIONAL DIFFUSION NETWORK

Mr. CROSS. Yes; of course. We do have a number of things that are going on. One is the national diffusion network, which operates in every State in the country. This is a system that is designed to disseminate validated programs, and we have been working with NSF.

We have about 15 of their programs in the system right now. We are working with them right now to get more of their programs in the network. This is a process in which locally developed programs have to show evidence that they have succeeded, and then they are paid to help get these programs out into other districts. We have facilitators who assist with that also.

Senator MIKULSKI. Well, why does it not happen?

Mr. CROSS. Well, I think that there is no single answer to that, quite frankly.

Senator MIKULSKI. Well, how about three?

Mr. CROSS. OK. I think one of the reasons is because you do have a problem with getting things down through a network in a school system, through a bureaucracy.

EISENHOWER PROGRAM

Second is, I think, one of the things we have to do is to get teachers more and more into the kind of programs which the Eisenhow-

er program sponsors in most States, and that is to get them into the kind of retooling efforts that Mr. Bloch mentioned earlier.

Also, through the Eisenhower program we have State coordinators, one for elementary and secondary and one for postsecondary science and one for elementary and secondary and one for higher education mathematics. We use those coordinators to get information out and, in fact, teachers are coming to these programs and are participating and getting good information.

The Eisenhower program has only been underway for a relatively short period of time. We are now in the sixth or seventh year. So we are now beginning to get some of these materials out, and we are beginning to see some good dissemination.

I will submit the abstracts of about 10 of the national programs that the Eisenhower program funds, organizations from the American Association of Physics Teachers to the AAAS, which will give you some sense of the kinds of activities that are going on and the plans which these organizations have.

Senator MIKULSKI. Well, I would be happy to welcome that.

[The information follows:]

DWIGHT D. EISENHOWER MATHEMATICS AND SCIENCE NATIONAL PROGRAMS

Abstracts of New and Continuation Awards

Dwight D. Eisenhower Mathematics and Science National Programs

Presented at the 1990 National Conference:

"The Critical Role of the Eisenhower Program in Meeting the National Education Goals in Mathematics and Science"

Sponsored by:
The United States Department of Education

Office of Educational Research and Improvement
Fund for the Improvement and Reform of Schools and Teaching

Office of Elementary and Secondary Education
School Improvement Programs

Rebecca Wilt, Allen Schmieder, Editors
Michael Mitchener, Compiler

INTRODUCTION

EXTRAORDINARY PROGRAMS TO MEET AN EXTRAORDINARY CHALLENGE

On the occasion of celebrating the 100th birthday of Dwight D. Eisenhower and gathering at the Second Joint National Conference on the Dwight D. Eisenhower Mathematics and Science Education Improvement Program, the Fund for the Improvement and Reform of Schools and Teaching Office is proud to present abstracts of the new and continuation grants awarded in 1990 under the National Program part of the Eisenhower Act. The Dwight D. Eisenhower Mathematics and Science Education Program is authorized under the Education for Economic Security Act as amended by the Hawkins-Stafford Elementary and Secondary Improvement Amendments of 1988. The purpose of the program is to support innovative projects of national significance directed at improving the quality of teaching and instruction in mathematics and science in the schools and to increase the access of all students to that instruction.

Collectively, these projects represent a vanguard of innovators in mathematics and science education who will help provide the kind of leadership needed to dramatically strengthen the quality of mathematics and science teaching and instruction in this nation's schools. These extraordinary programs focus on teacher training and curriculum change, K-12, and are directed at both increasing ongoing improvements in

mathematics and science education already initiated by some of America's foremost educational organizations and institutions and developing new models of change and reform for a broad range of educational settings. There is a strong emphasis on system-wide impact and funded projects including several state-wide programs and a variety of urban and rural school system programs. Although the target for most of the projects is the total student population, some priority is given to the underrepresented and underserved as well as the gifted and talented. Many of the projects rely upon the new technologies. All projects include strong documentation coupled with evaluation components so that program results can be effectively shared nationwide. Following are some examples of the outstanding programs included in this booklet.

FUND FOR THE IMPROVEMENT AND REFORM OF SCHOOLS AND TEACHING

FIRST Office

Richard T. La Pointe, Director ..... (202) 219-1495

James Williams, Deputy Director ..... (202) 219-1496

Mathematics and Science National Programs

Allen Schmieder, Program Director ..... (202) 219-2282

Rebecca Wilt, Program Coordinator ..... (202) 219-1496

Cindy Musick (Comprehensive Health Coordinator) ..... (202) 219-1496

Seresa Simpson (Educational Technology Coordinator) ..... (202) 219-1496

John Roddy (Computer-Based Instruction Coordinator) ..... (202) 219-1496

Other FIRST Programs:

Family-School Partnerships ..... (202) 219-1496

Schools and Teaching ..... (202) 219-1496

Fund for Innovation in Education (FIE) ..... (202) 219-1496

National School Volunteer Program ..... (202) 219-1496

Comprehensive School Health ..... (202) 219-1496

Technology ..... (202) 219-1496

Computer Assisted Instruction ..... (202) 219-1496

GENERAL CHARACTERISTICS OF PROGRAMS

1. Grant Holder Location. Grants holders are located in 27 States. the District of Columbia and American Samoa

2. Grant Service Area. Although grants are located in 27 states, all of the states in the nation will be receiving some level of services from the collective programs of the recommended projects. Many have national or multi-state audiences, and almost all are developing and/or articulating models that should have usefulness to science and mathematics educators across the nation. Approximately one-fourth of the projects are related to distance communication of one type or another. Plans are being explored to provide access to these programs by school systems and educators that are not currently linked to the program telecommunications systems.

3. Grant Holders.

   11 School Systems
   22 Institutions of Higher Education
   12 Consortiums
   8 Not for Profit Educational Organizations/Corporations
   5 ED R & D Centers
   3 State Educational Agencies
   2 Educational Associations
   2 Museums/Science Centers
   1 State Agency for Higher Education
   1 Insular Area
   1 Intermediate Educational Agency

4. Subject Distribution.

   17 Mathematics
   27 Science
   19 Mathematics and Science

5. Grade Level Distribution.

   26 Elementary
   19 Middle School/Secondary
   18 Elementary and Secondary

6. Project Length.

   32 - 3 Year Projects
   26 - 2 Year Projects
   5 - 1 Year Projects

SOME SELECTED PROGRAM TYPES OF SUPPORTED PROJECTS

Generally, programs give a heavy emphasis to system-wide curriculum reform, educational partnerships, the new technologies, and the importance of evaluation and dissemination.

- Multiple-State Regional Technical Assistance Consortiums
- National Curriculum Reform Implementation Models: at local, State, and national levels (NCTM Standards, NSTA Framework, 2061, NSF and NDN Programs)
- Model Demonstration Elementary Schools
- Model Demonstration Middle and Secondary Schools -- including State School for the Gifted
- Replication of Successful Urban Education Programs
- Improvement Programs Based on NDN Products and Networks
- National Curriculum Center - Major School System Partnerships
- Programs Directed at Strengthening Mathematics/Science Achievement of Chapter 1 Students
- Early Intervention/General Mathematics/Science Literacy Programs
- Museum and Science Center-based Programs
- Programs Directed at the Underserved and Underrepresented
- National and Regional Telecommunications Distance Learning Programs
- Scientist-Educator Partnership Programs
- Master/Mentor Teacher Programs
- New Special Elementary Science/Mathematics Certification Programs
- Special Education Programs

LIST OF CURRENT AWARDS

AMERICAN SAMOA

American Samoa Government* — Russell Aab (684) 633-5237

CALIFORNIA

California State Department of Education* — Thomas Sachse (916) 423-7187

California State University — Sharon Ross (916) 895-5700

Sweetwater Union High School District*	Harvey Warren (619) 691-5581
The Exploratorium	Robert Semper (415) 561-0318
The Rand Corporation*	Virginia Anders (213) 393-0411
University of California	Paul Saltman (619) 534-3330

COLORADO

Colorado Partnership for Educational Renewal	Carol Wilson (303) 629-6906
Mid-Continent Regional* Education Laboratory	Clare Hiedema (303) 337-0990
Mid-Continent Regional Education Laboratory	Toni Haas (303) 337-0990
St. Vrain Valley School District*	Sherri Stephens-Carter (303) 776-6200

DISTRICT OF COLUMBIA

American Association for the Advancement of Science	Marsha Lakes Matyas (202) 326-6670
National Audubon Society	Christopher Palmer (202) 547-9009
National Science Teachers Association*	Marily DeWall (202) 328-5800

FLORIDA

University of Miami	Dr. Gilbert Cuevas/Dr. Okhee Lee (305) 284-3006
University of North Florida	William Caldwell (904) 646-2496

IDAHO

University of Idaho	Terry Armstrong (208) 885-5762

ILLINOIS

Illinois State University*	Carol A. Thorton (309)438-8781

KANSAS

Comanche County Board of Education*	James C. Chadwick (316) 582-2181

KENTUCKY

Fayette County Public Schools	Ron Pelfrey (606) 281-0238
Oldham County Board of Education	Charleen McAuliffe (502) 222-8880
Ohio Valley Education Cooperative	Ken Jones (502) 452-2280

LOUISIANA

Lafayette Parish School Board	Mary Jane Ford (318) 267-7691

MARYLAND

American Association of Physics Teachers*	Jack M. Wilson (301) 345-4200
Western Maryland College	Skip Fennell (301) 857-2509
MD State Department of Ed.	Patricia Murphy (301) 581-4209

MASSACHUSETTS

Boston Public Schools*	Charlotte Harris (612)726-6200
Education Development Center, Inc.	Judith Opert Sandler (617) 969-7100

MICHIGAN

GMI Engineering & Management Institute	David Doherty (313) 762-9869
Michigan Technology Council*	William Cassell (313) 763-9757

MINNESOTA

University of Minnesota	Susan Henderson (612) 625-6361

MONTANA

Montana State University	Wayne J. Stein (406) 994-3881

NEW JERSEY

Educational Testing Service*	Ellen Mandinach (609) 734-5794

Ramapo College of NJ	Gabriella Wepner (201) 529-7530
Rutgers, The State University of New Jersey*	Rebecca L. Lubetkin (201) 932-2071

NEW YORK

Bank Street College of Education	Don Cook (212) 222-6700
Bronx High School of Science Fdn.	Vincent Galasso (212) 295-0200
City College of CUNY*	Hubert Dyasi (212) 690-4162
Rochester City School District	Douglas Llewellyn (716) 325-4560
SUNY College at Cortland	Bonnie Barr (607) 753-2467

NORTH CAROLINA

Gaston County Schools*	Jerry J. Bostic (704) 866-6462
University of NC	Peggy Franklin (919) 966-3256

NORTH DAKOTA

Diocese of Fargo	Donna Schwartz (701) 235-6429

OHIO

Ohio State University Research Fdn.	Greg Foley (614) 292-6471

OKLAHOMA

Oklahoma School of Science and Mathematics*	Edna Manning (401) 271-7676

OREGON

Columbia Education Center	Ralph T. Nelsen (503) 760-2346
Columbia Education Center*	Ralph T. Nelsen (503) 760-2346
NW Regional Education Laboratory	Steve Nelson (503) 275-9500
Oregon State University*	Margaret L. Niess (503) 754-4031

OREGON (continued)	
Western Educational Support Team	Ralph T. Nelsen (503) 760-2346
Western Educational Support Team	Ralph T. Nelsen (503) 760-2346
PENNSYLVANIA	
Carnegie Mellon University	Ann Baldwin Taylor (412) 268-2199
The Franklin Institute Science Museum*	Wayne Ransom (215) 448-1192
University of Pittsburgh	Lauren Resnick (412) 624-7485
SOUTH DAKOTA	
Dakota State College*	Jerald Tunheim (605) 256-5112
TEXAS	
Baylor College of Medicine	Linda W. Crow (713) 798-4613
Lewisville Independent School District	Greg Veal (214) 539-1551
SW Educational Development Laboratory	Preston Kronkosky (512) 476-6861
Texas Woman's University	Ruth Caswell (817) 898-2227
University of Houston	Mickey Hollis (713) 749-1685
VIRGINIA	
Education Network of VA	Judy McKight (703) 698-0487
WASHINGTON	
Educational Service District #101	Dick Moody (509) 456-7688
WEST VIRGINIA	
Science Education Enhancement Council	Mary Ellen Komorowski (304) 455-4400

* Continuation Awards

ELEMENTARY MATHEMATICS PROJECTS

ABSTRACT

Oregon State University

Contact Person: Margaret L. Niess
Corvallis, OR 97331
(503) 754-4031

CURRICULUM DEVELOPMENT AND LEADER TRAINING FOR MIDDLE SCHOOL TEACHERS OF MATHEMATICS, GRADES 6 THROUGH 8

Application No:	R168D 90164
Amount of Award:	$179,734
Budget Period:	09/01/89 - 08/31/91
Duration of Project:	24 months
Project Period:	09/01/89 - 08/31/91

Step one of this curriculum development project is to integrate state curriculum guidelines and National Council of Teachers of Mathematics Standards into middle school mathematics, and next, to combine the wide range of instructional tools available to teach mathematics today including both low (manipulative) and high technology. A symposium for the identification of the major content strands and accompanying resource materials will be held at Oregon State University with a writing team developing pilot materials at the symposium's conclusion.

The second step of the project is the preparation of leaders to assist in the integration of the curriculum materials into middle school mathematics instruction. Twenty middle school mathematics teachers, grades 6 through 8, will participate in staff development and leadership training. The participants will receive 24 credit hours of graduate course work designed specifically to increase their knowledge and skills in mathematics, curriculum design, curriculum implementation, leadership skills, and instructional strategies. These teachers will return to their schools and districts in the second year as leaders to assist in the integration of these curriculum materials into mathematics classrooms, to assist in staff development, and to act as resource persons for middle school mathematics.

ABSTRACT

Boston Public Schools

Contact Person: Charles Ramsey
26 Court Street
Boston, MA 02108
(617) 282-3440

"BASIC PLUS" FOR URBAN SCHOOLS

Application No:	R168A 90064
Amount of Award:	$180,000
Budget Period:	08/01/90 - 07/31/91
Total Award to Date:	$380,000
Duration of Project:	36 months
Project Period:	08/01/89 - 07/31/92

Located in Boston, Massachusetts, "Basic Plus" aims to improve mathematics instruction in grades 3-5 by refocusing instruction from that which is exclusively computation to instruction that combines computation, exploration, reasoning, communication, and technology. One goal of the program is to boost teacher quality

by improving the qualifications and skills of intermediate elementary grade teachers with computers, calculators, math video tapes, and math team competitions. A second objective is curriculum development focusing on grades three through five with a teacher handbook of activities and lesson plans that successfully teaches a higher order of math skills. A third aim is to increase student achievement in standardized mathematics tests in participating teachers' classrooms by 10 points by the end of the year.

ABSTRACT

Illinois State University

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PROJECT TEAMS: TEAM APPROACH TO DEVELOPING MATHEMATICS RESOURCE TEACHERS, K-3

Application No:	R168A 90270
Amount of Award:	$115,000
Budget Period:	08/01/90 - 07/31/91
Total Award to Date:	$223,825
Duration of Project:	36 months
Project Period:	08/01/89 - 07/31/92

This project is a three-year program emphasizing a cooperative Public/Private School District/Illinois State University TEAM Approach to Developing K-3 mathematics resource teachers. The primary objective is to formulate and test a model which promotes confidence and teaching competence in 56 teachers to enable them to be effective building resource leaders for planning and implementing an appropriate primary mathematics program consonant with National Council of Teachers of Mathematics Standards (1989) and current research recommendations.

During each of the three project years, teams of two to three project teachers and a staff mentor will collaborate to co-plan and co-present one of twenty-four academic year, grade level seminars and one subsequent session on the same topic embedded in a two-week summer workshop. The major thrust is involving the teacher resource leaders in shaping primary mathematics programs that are conceptually oriented, cognitively guided, developmentally appropriate, and tied to major goals of problem solving, critical thinking and communicating. On-site activity in TEAMS teachers' classrooms during the second project year will involve collaboration between staff and individual teachers in co-planning and presenting model lessons. The third year will involve the primary specialists in demonstration teaching lessons for other grade level teachers in their building and to administrative, parent, local, regional and state teacher groups.

The project will directly affect 56 TEAMS teachers and approximately 1200 primary students. The demonstration teaching, district and state-level workshop activity carried out by TEAMS teachers increases project outreach to an approximately 200 teachers and nearly 5000 primary children.

This activity will further affect Illinois State University education majors conducting practicums/student teaching in Project TEAMS schools. Over one-fifth of all Illinois teachers are graduates of the University.

ABSTRACT

St. Vrain Valley School District

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IMPROVING SCHOOL MATHEMATICS: ASSURING THE TRANSFER FOR RESEARCH TO PRACTICE

Application No:	R168A 90201
Amount of Award:	$25,000
Budget Period:	09/01/90 - 08/30/91
Total Award to Date:	$211,282
Duration of Project:	36 months
Project Period:	09/01/89 - 08/31/92

This project will support and encourage practical classroom implementation of an elementary mathematics program. Teachers who successfully complete an elementary level mathematics education class (30 class hours) will be allowed to spend $300 on manipulative materials to be used in the classroom.

All teachers who successfully complete an elementary level mathematics education class (30 hours of training) will receive two days of released time to engage in grade level collaboration, coaching, or classroom visitation.

And each teacher who successfully completes an elementary level mathematics education class (30 class hours) will receive one day per quarter released time to engage in preparing materials, writing, and planning curriculum units as well as working with math specialists to implement the elementary and mathematics program.

ABSTRACT

University of Houston

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CALCULATOR MATHEMATICS CURRICULUM FOR GRADES 6 - 8

Application No:	R168D 00311
Amount of Award:	$87,467
Budget Period:	08/01/90 - 07/31/91
Duration of Project:	36 months
Project Period:	08/01/90 - 07/31/93

This project will create a model calculator curriculum for grades 6-8 in the Alief Independent School District as a supplement to the approved textbooks adopted for 1991-99. This curriculum will be available for dissemination to other schools in Texas; and because texts adopted in Texas are frequently in widespread use throughout the U.S., it will be available for national dissemination. The calculators to be used are fraction and scientific calculators; exploration of other hand-held technologies (e.g., graphing calculators) will be begun as such technologies become available during the life of the project.

The project will last three years: August 1990 to July 1993. In the first year calculator inservice will be offered to all mathematics teachers in grades 6-8, and

inservice on the Gender/Ethnic Expectations and Student Achievement program will be provided to mathematics department chairs. Drafts of instructional activities will be developed and piloted by a team of teachers within each of the five middle school buildings. Science department chairs will serve as consultants to help tie together mathematics and science instruction. In summer 1991, materials will be revised to fit the new texts and development of assessment procedures. In the second year, instructional activities will be expanded and revised; all materials will be finished during summer 1992, along with completion of the assessment procedures. In the third year, the materials will be thoroughly tested, with appropriate data gathered so that the project will be eligible for inclusion in the National Diffusion Network. Final revisions will be made during summer 1993. The materials will be evaluated through examination of students work (e.g., student projects, responses to direct questions on ways to use a calculator, standard tests), interviews of selected students, and classroom observations.

Project teachers will also keep journals about students' reactions to the materials, problems in using the materials, etc. These journals will be used to build a case history of the progress of the intervention.

The project is a district wide implementation of a curriculum that will be thoroughly tested as it is developed in a district with a changing student population. Because this is a supplementary curriculum, it would be easily accessible for other schools nationally to use. The curriculum is based on technologies that are readily available to schools, and it also addresses technologies that will become available during the life of the project. It involves middle school mathematics, a critical period in maintaining students' interests in taking future mathematics and science courses. The evaluation component will generate information that will improve our understanding of the ways that technology can be used in teaching mathematics.

ABSTRACT Mid-Continent Regional Educational Laboratory

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CSMP/21: COMPREHENSIVE SCHOOL MATHEMATICS PROGRAM

Application No:	R168D 00400
Amount of Award:	$120,000
Budget Period:	08/01/90 - 07/31/91
Duration of Project:	30 months
Project Period:	08/01/90 - 01/31/93

The overall goal of the project is to develop a comprehensive elementary school mathematics program with heavy science and technology components that will develop the necessary interest and enthusiasm among all children and especially among minorities and females. The program is to include classroom materials, teacher training, and parental involvement.

The program is divided into two phases: planning and preparation/development and evaluation. Planning and preparation tasks will prepare for an efficient and effective project as well as set the stage for effective implementation, assessment, and dissemination efforts. Tasks involve soliciting experience data, identifying test and development sites, and preparing a curriculum revision framework. Development and evaluation tasks will use classroom-based experimental teaching, local testing and national pilot testing to inform the preparation of teacher and classroom materials. Development of teacher-training and parental information components will parallel that of classroom materials. Finally, the project will plan for national dissemination and continuous support.

ABSTRACT

Ohio Valley Educational Corporation (OVEC)

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PROJECT TEAMS - TEACHERS EDUCATED ABOUT MATH STANDARDS

Application No:	**R168D 00269**
Amount of Award:	**$266,060**
Budget Period:	**08/01/90 - 07/31/91**
Duration of Project:	**36 months**
Project Period:	**08/01/90 - 07/31/93**

Project TEAMS will provide a model of teacher training especially suited to rural and suburban school districts that could be replicated in rural regions throughout the United States. The major emphasis of training in this program is for mathematics teachers in grades 5-8.

A survey completed by 78% of the 5th-8th grade math teachers in the 13 OVEC school districts indicated that 62.8% are not familiar with the Standards, and 19.9% rank their math anxiety as high or very high. In addition, their responses to specific questions indicated that over 98.7% had understandings, beliefs and attitudes in direct conflict with the Standards. "Project TEAMS" will give teachers the knowledge and skills they need to improve their understandings, beliefs and attitudes and change these statistics. The project will also ultimately impact on student attitudes and learning.

The first year of the three-year program provides extensive training for 54 "math coordinators" (one teacher from each school housing 5th-8th graders). These coordinators will field test the new concepts and activities in their own classrooms and informally share information from their training with their colleagues. Project staff and math coordinators will be involved in the production of eight video training modules for use in the project's second year.

During the second year, training will extend to the remaining 167 5th-8th grade math teachers, via staff and the math coordinators. State and national dissemination of the project will begin during the third year.

ABSTRACT

Oldham County Board of Education

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MATH CONNECTIONS: K-5 MODEL MATHEMATICS SUPPORT PROJECT

Application No:	**R168D 00195**
Amount of Award:	**$132,478**
Budget Period:	**07/01/90 - 06/30/91**
Duration of Project:	**24 months**
Project Period:	**07/01/90 - 06/30/92**

The Math Connections project enables a team of mathematics educators to develop and disseminate a model K-5 mathematics support program directly correlated and integrated with the Standards and the Framework. The Oldham County Board of

Education is coordinating the project in cooperation with dissemination agencies and mathematics educators from the Kentucky Department of Education and state universities. The model project includes:

1. Instructional resource units correlated with the Standards and utilizing existing resources and new technologies to support instruction;

2. Teacher-training modules focusing on the integration of the resource units in classroom instruction;

3. Parent-training and communication modules preparing parents to actively support and be directly involved in the teaching-learning process;

4. A variety of performance-based evaluation techniques; and

5. Procedures for dissemination of resource units, teacher and parent training modules and performance-based summative assessments.

Math Connections is consistent with the Kentucky three year plan under the Eisenhower Mathematics and Science Education Act. The Kentucky Department of Education, Kentucky Educational Television and Kentucky Congress of Parents and Teachers will be instrumental in the implementation and dissemination of the model project. Math Connections has the potential to directly benefit the 334,232 elementary students in the 1,207 public and nonpublic elementary schools in Kentucky.

ABSTRACT

Lafayette Parish School Board

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TEACHER TRAINING FOR ELEMENTARY MATHEMATICS LEARNING: A METHODOLOGICAL APPROACH EMPHASIZING CONCEPTS, APPLICATIONS AND PROBLEM SOLVING

Application No:	R168D 00475
Amount of Award:	$70,000
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	12 months
Project Period:	07/01/90 - 06/30/91

Through a series of eight, four-hour workshops and two summer courses, the project will provide in-service teachers with the training and experiences necessary to implement a series of changes in the elementary mathematics curriculum that reflect the new NCTM standards. Eighty participants will be enrolled in each workshop and the summer courses. Workshop participants will receive a stipend and tuition and materials will be provided for summer course participants. Two faculty members from the Department of Curriculum and Instruction will conduct the workshops and summer courses. The project will be administered by a steering committee composed of these two faculty members, a professor from the Department of Educational Foundations, a professor from the Mathematics Department, and the Lafayette Parish Elementary Mathematics Supervisor. Evaluation of the program will consist of pre- and post-tests for workshop participants, evaluations of the workshops, regular grading procedures for course work, and follow-up of selected participants.
This project is a cooperative effort of the Lafayette Parish School Board and the University of Southwestern Louisiana.

ABSTRACT — Fayette County Public Schools

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DIME: DEVELOPING INTEGRATED MATHEMATICS EXPERIENCES PROJECT

Application No:	**R168D 00272**
Amount of Award:	**$100,000**
Budget Period:	**08/01/90 - 07/31/91**
Duration of Project:	**24 months**
Project Period:	**08/01/90 - 07/31/92**

The DIME Project is a two-year program. In the first year, the emphasis is on mathematical problem solving and use of manipulatives. In the second year, mathematics connections and technology will be emphasized. The use of cooperative learning will be a common thread developed throughout both years. The program is designed to develop leadership expertise with one teacher from each of the ten middle schools. These ten teachers will serve as peer coaches for the other mathematics teachers in their respective schools.

All sixty middle school teachers will receive staff development training. This training will involve three days of inservice each summer followed by three-hour workshops on one Saturday each month of the school year and bi-monthly dinner meetings/sharing sessions.

Successful implementation of any new mathematics program can only be attained through leadership at the school level and through intensive staff development. The goal of this project is to restructure the way the middle school mathematics in Fayette County Public Schools is delivered to students by helping teachers redirect the present computation-based curriculum into a problem solving-based curriculum.

ABSTRACT — Education Network of Virginia

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PROJECT HOME: HANDS-ON MATHEMATICS EDUCATION

Application No:	**R168D 00095**
Amount of Award:	**$20,000**
Budget Period:	**09/01/90 - 08/31/91**
Duration of Project:	**36 months**
Project Period:	**09/01/90 - 08/31/93**

The National Diffusion Network's Virginia and West Virginia Facilitator Projects will coordinate and sponsor *Project Home: Hands-on Mathematics Education*, a two-year, five-phase mathematics in-service program for public and private school elementary mathematics teachers. Sixty (60) selected teachers from the rural and mountain counties of western Virginia and eastern West Virginia will participate.

In August of 1991, participating teachers will take part in a week-long workshop that will introduce them to a specific developmental mathematics sequence and train

them to use manipulative materials, questioning, problem solving, and writing strategies to enhance mathematics literacy, as suggested by the National Council of Teachers of Mathematics' report "Curriculum and Evaluation Standards for School Mathematics." Each teacher will receive the materials and guides needed to implement and use the strategies presented.

During the 1991-92 school year, teachers will pilot strategies with their students. Implementation and follow-up will be the focus of this phase. A second week of training in the spring of 1992 will prepare teachers to conduct formal, turnkey training sessions for their peers and colleagues.

During the summer and fall of 1992, Project HOME teachers will lead in-service workshops for their peers. During the spring of 1993, teachers will come together for a final week that will focus on turnkey training follow-up and an analysis of the pre-/post-test results and other evaluation/impact data collected during the project.

All costs associated with this workshop series will be covered by this grant and the two facilitator projects, including training costs, material costs, teacher release time, and related costs for trainers and participants.

ABSTRACT

California State University
Chico University Foundation

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BEYOND ACTIVITIES PROJECT: A SECOND-STAGE PROFESSIONAL DEVELOPMENT MODEL FOR MATHEMATICS, GRADES 4-6.

Application No:	R168D 00390
Amount of Award:	$107,029
Budget Period:	10/01/90 - 09/30/91
Duration of Project:	36 months
Project Period:	10/01/90 - 09/30/93

The Beyond Activities Project will design, implement, and evaluate a professional development model which involves teachers developing thematic teaching units in conjunction with a summer Young Mathematicians Program. Objectives include:

1. Provide a professional development opportunity for 81 teachers to collaboratively develop and pilot integrated, thematic mathematics units.

2. Provide an extraordinary mathematics learning opportunity for 416 students who will participate in three summer Young Mathematicians Programs.

3. Develop, pilot-test, and revise 18 thematic teaching units.

4. Conduct workshops to disseminate nine of the thematic units which have been professionally edited and published.

In the first two summers, teachers will gather on the CSU Chico campus for five weeks to develop and to teach thematic curriculum units to students in the YMP classes. During the following academic years, teachers will pilot the developing materials in their own classrooms. In the third summer, the Beyond Activities Project model will be extended to three participating school districts. Also, during the third year, thematic curriculum units will be disseminated through other professional development programs.

The project will provide two vital resources to the reform effort. First, the thematic teaching curriculum units developed will provide concrete examples of what such instructional materials might look like. Second, teachers participating in the project will gain experience with, and enthusiasm for, the thematic unit idea. They can serve as leaders not only in their own districts but across the state.

ABSTRACT

Western Maryland College

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TEACHING FOR NUMBER SENSE NOW! REACHING THE NCTM STANDARDS

Application No:	R168D 00134
Amount of Award:	$145,000
Budget Period:	08/01/90 - 07/30/91
Duration of Project:	24 months
Project Period:	08/01/90 - 07/31/92

Students need to understand what happens with numbers, and teachers must feel comfortable teaching such concepts. In order for students to develop flexibility in expressing numbers, they must see numbers in a variety of contexts and situations. Sometimes this will be an exact response, sometimes not. "The major objective of elementary school mathematics should be to develop number sense" (Everybody Counts, 1989, p.46). Number sense is important for all of us. It is the ability to use number concepts with the least amount of effort. Students who have number sense. understand numbers and know how and when to use them. Students with number sense have multiple meanings of numbers, operations and the use of the procedural aspects of early mathematics learning activities. The elementary student of the 1990's must have number sense. It is the basic skill of the decade. Knowledgeable teachers are the key to insuring that number sense becomes a high priority in all classrooms.

The project will produce a set of three videotapes and accompanying print support materials, to demonstrate and promote number sense, utilizing approaches consistent with and supporting the National Council of Teachers of Mathematics' (NCTM) Curriculum and Evaluation Standards for School Mathematics. The project videotapes will be designed for elementary school teachers and will involve classroom teachers actively engaged in number sense activities with children.

The purpose of the program is to inform the classroom teacher of the importance of number sense as a critical element in mathematical communication. This project will show teachers how number sense can be an integral component of their daily mathematics teaching. The project will involve NCTM, the NCTM

Task Force on Number Sense, Western Maryland College, the Baltimore, Carroll and Howard County Public Schools (MD) and the Washington, DC Public Schools. The impact of the program is in the area of teacher and curriculum improvement. This project has national implications because, prior to the release and discussion of the NCTM Curriculum and Evaluation Standards for School Mathematics, number sense was not included in elementary teacher preparation programs. The intent of the project is to encourage teachers to use the number sense instructional activities and strategies exemplified in the NCTM Standards. Project teachers, selected from the participating school districts, will help create lessons which involve number sense and accompanying print support materials. There will be 6-7 project teachers at each of three instructional levels (grades 1-2; 2-4; and 4-6). Completed videotapes and print materials will be provided (gratis) to each state mathematics supervisor. Additional tapes will be made available through NCTM.

ABSTRACT

Montana State University

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AIM: AMERICAN INDIANS IN MATHEMATICS PROJECT

Application No:	R168D 00392
Amount of Award:	$145,000
Budget Period:	09/1/90 - 08/31/91
Duration of Project:	36 months
Project Period:	09/01/90 - 08/31/93

American Indians are severely underrepresented in such important quantitatively-based fields as mathematics, the sciences, computer technology and other technical fields. The problem is exacerbated by Indian students' low participation and inadequate preparation in mathematics curricula at the junior high and secondary school levels. In response to these concerns of national significance, the Center for Native American Studies, Montana State University (MSU), proposes to establish Project AIM, a three-year training program for American Indian students and their mathematics teachers from rural reservation schools. The objectives of the project are twofold: 1) to increase the participation of first-generation, college-bound Indian students in quantitatively-based curricula; and 2) to strengthen the quality of mathematics instruction in schools serving predominantly Native American students.

To accomplish the project objectives, the Center for Native American Studies, in cooperation with the Department of Mathematical Sciences, has designed an integrative, interactive mathematics learning support system--a learning enterprise involving Indian students, as well as their teachers and parents. The Project AIM design incorporates six major components:

1. A four-week Summer Institute in "Exploring the World of Mathematics and Computers" for 21 American Indian students who are entering grades 9 and 10. The Institute will provide supplemental computer-assisted instruction in mathematics and career exploration of quantitatively-based fields.

2. A six-week Summer Institute in "Integrating the World of Mathematics and Computers" for ten high school mathematics teachers from rural reservation schools. The Institute will provide inservice training in the integration of computer technology in instruction and curriculum development.

3. A training program involving parents of first-generation college-bound students, which will engage them in activities to support and motivate their children.

4. Curriculum development activities designed to improve the mathematics curricula at Indian reservation schools through the integration of computer technology and culturally-relevant content.

5. A multi-tiered follow-up program between MSU and the participating parents, students and teachers, with an ongoing inservice training program for other, non-participating teachers in target schools.

6. Dissemination of the project's impacts determined by longitudinal studies of project participants' subsequent activities and academic performance, which will be published in professional journals and presented at state/regional/national conferences.

ABSTRACT

University of Pittsburgh

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MATHEMATICAL REASONING IN PRIMARY SCHOOL: A TEACHER DEVELOPMENT AND CLASSROOM IMPLEMENTATION PROJECT

Application No:	R168D 00191
Amount of Award:	$126,172
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	36 months
Project Period:	07/01/90 - 06/30/93

This project responds to national calls for early mathematics teaching that stresses the meaning of numbers and operations and the development of number sense and estimation skills. It aims to implement in a number of primary schools an instructional program built around whole class and small group discussion of children's invented solutions to arithmetic problems. Developed and tested in an inner-city school serving a largely minority population, the program builds children's conceptual understanding, produces substantial gains in computational skill, and develops children's confidence in their mathematical capabilities.

The project will implement an inservice education program for teachers that engages them in a professional process of designing a plan for their own teaching, based on research findings and concepts and the experience of teacher colleagues. In the Development Phase of the project, summer workshops and monthly inservice meetings will be led by the teachers who collaborated with researchers in developing and piloting the new instructional program. Participant teachers will read and analyze relevant research articles, plan teaching strategies and try them in a laboratory classroom environment, study and critique videotapes of small group and whole class lessons, and develop curriculum plans for their classrooms. The lead teacher and the participants will also visit each other's classrooms during the course of the two year training and implementation period. In the Dissemination Phase of the project, two participant teachers from the Development Phase will assume leadership of the workshops and inservice meetings.

University research staff will conduct a project evaluation to determine how well the instructional principles have been communicated, how participating teachers have implemented the instructional program in their classrooms, and the effects of the program on children's computational and mathematical reasoning abilities. By the end of the three-year project, 60 teachers will have implemented the program in their classrooms, and a regional network for further training and program implementation will have been created.

SECONDARY MATHEMATICS PROJECTS

ABSTRACT

The Rand Corporation

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A NOVEL COURSE IN ALGEBRA INTEGRATING COMPUTER TOOLS

Application No:	R1568D 90023
Amount of Award:	$430,365
Budget Period:	10/01/89 - 09/31/91
Duration of Project:	24 months
Project Period:	10/01/89 - 09/31/91

To implement this project, a ten-week course in high school algebra will be developed that is novel in several respects. First, the course will include several units which are not found in traditional freshman algebra curricula, including mathematical modeling, functions, and statistics. One of the units has been piloted in Rand's preliminary efforts to develop a novel algebra curriculum. Secondly, the course will be built around several computer-based educational tools. The tools will extend those Rand has previously developed and piloted in classrooms. Thirdly, Rand will provide several new instruments for assessing student learning, and finally, the project will develop and test teacher training materials and conduct and evaluate teacher training workshops relative to the computer.

ABSTRACT

Ohio State University

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COLLEGE READINESS VIA TECHNOLOGY-ENHANCED MATHEMATICS

Application No:	R168D 00369
Amount of Award:	$160,000
Budget Period:	10/01/90 - 09/30/91
Duration of Project:	36 months
Project Period:	10/01/90 - 09/30/93

This project will provide an intensive inservice experience for 144 high school teachers from across the nation--72 in Summer 1991 and 72 in Summer 1992--to prepare them to use a computer-and calculator-based approach to teaching and learning mathematics. The participants will then teach using exemplary curricular materials that emphasize concepts, problems, and processes focusing in depth on key ideas. To help ensure that the intended curricula and methods are implemented, program staff will provide follow-up inservice support for the participating teachers during the school year. Participants will be expected to carry out a plan to disseminate the approach to other teachers in their local areas.

There will be two strands of inservice--a Precalculus Strand and a Calculus Strand. The Precalculus Strand will build on the Ohio State University Calculator and Computer PreCalculus project and will develop conceptual underpinning for calculus

in an interactive computer graphics environment. The Calculus Strand will build on the Oregon State University Calculators in the Calculus Curriculum project and will explore the ideas of calculus using symbol mathematics (computer algebra) systems. The activities for both strands are designed to enable teachers to use technology to establish concepts and to use graphs as tools for visualization and problem solving. In addition, calculus teachers will gain skills in using symbolic mathematical systems to help shift their students' attention from computational details to higher-order processes. The techniques and technology to be used in the project are almost directly applicable to other high school mathematics courses, especially algebra.

ELEMENTARY SCIENCE PROJECTS

ABSTRACT — California State Department of Education

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RESTRUCTURING THE HIGH SCHOOL SCIENCE CURRICULUM

Application No:	**R168D 90145**
Amount of Award:	**$580,000**
Budget Period:	**08/20/89 - 08/19/91**
Duration of Project:	**24 months**
Project Period:	**08/20/89 - 08/19/91**

The purpose of this project is to create a mechanism for the restructuring of the science curriculum sequence throughout California by increasing the quantity and quality of time students spend learning science from grade 7-12, and by offering science education alternatives for the large numbers of females and minorities in situations where they would otherwise not enroll in science classes.

The proposed project would create a vehicle by which high schools (some in collaboration with middle schools) take on the task of designing and implementing one of four models developed by the National Science Teachers Association and the draft California Science Framework. This proposal would provide funds for 100 of the approximately 800 California high schools to develop a dramatically revised curriculum so that the four models would exist throughout the state. Basically, the plan is to allow principals and the leadership team for a given school to develop innovative courses and teaching techniques to improve the caliber of learning in mathematics and science. The plan here is to use the leadership of department chairs at 100 reform-minded high schools to begin restructuring of the science sequence.

ABSTRACT — Dakota State University

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PHYSICS AND CHEMISTRY TOPICS AND ACTIVITIES FOR ELEMENTARY TEACHERS AND THEIR STUDENTS

Application No:	**R168A 90178**
Amount of Award:	**$120,000**
Budget Period:	**10/01/90 - 09/30/91**
Total Award to Date:	**$263,828**
Duration of Project:	**36 months**
Project Period:	**10/01/89 - 09/30/92**

This project will evaluate and modify a highly successful workshop and develop it into a video-assisted self-learning format that will allow nation-wide dissemination. The workshop was in response to the critical need to improve the educational content of the elementary grades in the areas of chemistry and physics. The curriculum materials and hands-on activities have undergone extensive testing at the South Dakota State University Laboratory School and in over 200 classrooms in the states of Washington and South Dakota.

Participants in this project will be instructed using two different modes of delivery. The first group of 172 teachers will be instructed in the same workshop format as used previously. The other group of 48 teachers, in subgroups of six teachers each, will utilize the video-assisted self-learning packets facilitated by another elementary teacher. The facilitator for four subgroups will be a teacher who has previously taken the workshop, implemented it in his or her classroom, and undergone a four-hour orientation session. The other four subgroups will be led by a teacher with only the orientation session for background. The two modes of instruction will then be evaluated as to their relative effectiveness in imparting knowledge to the teachers and causing implementation of the hands-on activities in the classroom. If the video-assisted materials prove to be effective, this project will extend a highly successful physics and chemistry workshop to teachers throughout the Nation.

ABSTRACT — The Franklin Institute Science Museum

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CESTA: COMMONWEALTH ELEMENTARY SCIENCE TEACHING ALLIANCE

Application No:	**R168A 90041**
Amount of Award:	**$199,813**
Budget Period:	**09/01/90 - 08/30/91**
Total Award to Date:	**$398,038**
Duration of Project:	**36 months**
Project Period:	**09/01/89 - 08/31/92**

The Franklin Institute (Philadelphia, PA) Science Museum Project will develop a nationally important statewide network for the enhancement of hands-on science education. Funds will support the establishment of The Commonwealth Elementary Science Teaching Alliance (CESTA), a large-scale systematic collaboration to improve

the quality of elementary teachers' skills in activity-based science pedagogy. This project has the strong endorsement and support from the Pennsylvania Department of Education which was centrally involved in the initial stages of program development and has committed state funds to program implementation, pledging support to CESTA's long-range objectives and continuation.

The first three years of the CESTA project will establish six Regional Centers throughout Pennsylvania to support a total cadre of 162 teachers and curriculum administrators as 54 hands-on Science Leader Teams that will train other educators in hands-on science study. The Leader Teams will be trained in three intensive Leadership Training Institutes and the Regional Centers will be permanently supported by local community partnerships. At the conclusion of Federal support, the 54 Leader Teams will have offered 432 workshops for approximately 6,480 peers. ED funds will thus indirectly serve 194,400 students - over 23% of the elementary student population in Pennsylvania. Most importantly, CESTA will have served as a large-scale demonstration project for systematic reform and improvement in the quality of elementary science education and may serve as a national model for similar projects throughout the country.

ABSTRACT

Columbia Education Center

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TECHNOLOGICAL APPLICATIONS FOR SCIENCE EDUCATION LEADERSHIP

Application No:	**R168A 90034**
Amount of Award:	**$180,187**
Budget Period:	**10/01/90 - 09/30/91**
Total Award to Date:	**$352,803**
Duration of Project:	**24 Months**
Project Period:	**10/01/89 - 09/30/91**

The Columbia Education Center (CEC), representing educational agencies in fifteen western states, will implement a two-year project that will: (1) improve the elementary science education curriculum; (2) enhance the instructional skills of elementary teachers in the area of science; and, (3) demonstrate the efficacy of technological "distance" learning systems for providing staff development and curriculum improvement services to small-town and rural schools. States participating are Alaska, Arizona, California, Colorado, Hawaii, Idaho, Kansas, Montana, Nevada, New Mexico, Oklahoma, Oregon, Utah, Washington, and Wyoming.

The project will emphasize activities to support the regional demonstration and institutionalization of exemplary methods and materials drawn from one of the nation's finest elementary science models - the STARWALK program developed jointly by the Colonial School District and McCollough Planetarium in Delaware. Selection of this exemplary program has been guided by the recommendations of CEC planners in each of the participating states.

The project's principal audience will include ninety elementary educators, six from one school in each of the fifteen states. These schools and personnel will be provided both "distance" and "in situs" services leading to the institutionalization of the STARWALK program in classrooms, grades two through six. "Distance" activities will comprise a series of monthly training sessions delivered via videotape and interactive satellite teleconferences. "In situ" training will include a two-week Summer Institute in 1990 which will prepare two representatives from each of the participating schools to become Leadership Teachers. These thirty persons will represent STARWALK in their respective states, making awareness presentations, conducting in-service workshops, and serving as downlink coordinators for satellite training activities.

ABSTRACT

Gaston County Schools

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STATT: SCIENCE TEACHING AND THINKING FOR TOMORROW

Application No.:	R168A 90019
Amount of Award:	$120,000
Budget Period:	09/01/90 - 08/31/91
Total Award to Date:	$257,716
Duration of Project:	36 months
Project Period:	09/01/89 - 08/31/92

"Science Teaching and Thinking for Tomorrow" will provide a comprehensive, K-6 program for the improvement of elementary science teaching skills and qualifications in the Gaston County Schools while serving as an exemplary hands-on, high-technology model for other school systems throughout the Nation.

The purpose of the program is to provide immediate training to approximately 360 elementary science teachers over a three year period, while implementing a highly cost-effective hands-on science experiential program.

ABSTRACT

City College of CUNY

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DEVELOPMENT OF TEACHERS AS SCIENCE INQUIRERS

Application No:	R168A 90083
Amount of Award:	$125,796
Budget Period:	10/01/90 - 09/30/91
Total Award to Date:	$228,183
Duration of Project:	36 months
Project Period:	10/01/89 - 09/30/92

This project administered by the City College Workshop Center in collaboration with Community School District Five and Eight (in the Harlem and the South Eastern Bronx areas of New York respectively) is a three-year program to increase the qualifications and skills of 90 K-6 teachers in order to provide quality science inquiry instruction to elementary school children. In addition, the program will develop participants' skills to support science education of other elementary school teachers, and to help parents support their children's inquiry activities at home. The first year will train 30 third and fourth grade teachers; the second and third year will focus on 30 early childhood and on 30 fifth and sixth grade teachers respectively. Participant teachers will earn six tuition-free graduate credits towards a masters degree. The project begins with 3rd and 4th grade teachers because New York State's Elementary Science program evaluation is currently focused on the fourth grade.

Indicators of the program's success will include: (1) changes in teachers' understanding of the nature of science and of elementary school science inquiry; (2) deepened capacity to practice science inquiry focusing on common phenomena; (3) articulation of a professional rationale for science inquiry instruction; (4) evidence of sustained involvement of children in, and their attachment to, science inquiry, and; (5) teachers' proper use of related educational resources including educational technology. Additional indicators will be the degree to which the teachers support and network with one another and how they articulate their classroom practices and children's needs to parents and to other interested groups.

ABSTRACT — Rutgers, The State University of New Jersey

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SCIENCE TEAMS

Application No:	**R168A 90224**
Amount of Award:	**$241,355**
Budget Period:	**09/01/90 - 08/31/91**
Total Award to Date:	**$333,632**
Duration of Project:	**24 months**
Project Period:	**09/01/89 - 08/31/91**

This project will increase elementary teachers' skills in science content and hands-on experiments, and in cooperative learning classroom management techniques. Building on a feasibility study piloted with selected New Jersey school districts, SCIENCE TEAMS will promote positively the interest, motivation and involvement of upper elementary students, especially minorities and females, in science and in science careers.

In Year I, SCIENCE TEAMS will provide training and materials in cooperative learning techniques developed at Johns Hopkins University to 30 elementary teachers from 15 racially-mixed districts. These techniques are designed to reorganize the learning environment to encourage leadership opportunities, self-confidence and opportunities for achievement in science for all students, especially girls and minorities.

During August 1990, the teachers will attend a week-long Summer Institute in environmental science at Rutgers University. This Institute, developed by the two science consultants, will provide both science content and laboratory methodology for hands-on activities appropriate for a cooperative learning approach in the fifth and sixth grade science classroom.

In Year II the teachers will get additional training and assistance to integrate the environmental science content with cooperative learning techniques in units to be field tested during the first and third marking periods in their classroom.

A multi-media training package, consisting of videotape, curriculum units and training manual, will be produced to disseminate this project nationally.

ABSTRACT — University of Minnesota

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RESEARCH EXPLORATIONS FOR TEACHERS

Application No:	**R168D 00101**
Amount of Award:	**$60,000**
Budget Period:	**01/01/91 - 12/31/91**
Duration of Project:	**36 months**
Project Period:	**01/01/91 - 12/31/93**

"Research Explorations for Teachers" will enable elementary teachers to join for periods of two to four weeks, University of Minnesota faculty teams engaged in scientific research. Afterwards, teachers will develop curricular material that relates to the content and inquiry-based approach of their research experiences; they will teach their curriculum modules in their own classrooms the next year. Selected modules then will be published and distributed to Minnesota school districts. Two short seminars, held before and after the research experiences, will focus on trends in recent scientific research and pedagogical issues in science education. A third seminar, held eight months after the second, will focus on the evaluation of the curricular material.

This project's collaboration between precollege teachers and University faculty will model a unique but replicable approach to improving science teaching. This model allows teachers to experience inquiry-based learning; provides them with current scientific information; supports the development of science curriculum that incorporates active learning; and fosters the formation of networks between precollege teachers and University faculty. The improved quality of science teaching that results will also significantly aid in the recruitment of students for science careers.

ABSTRACT

Carnegie Mellon University

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INTENSIVE SCIENCE METHODS AND CONTENT TRAINING PROGRAM

Application No:	**R168D 00219**
Amount of Award:	**$115,000**
Budget Period:	**07/01/90 - 06/30/91**
Duration of Project:	**36 months**
Project Period:	**07/01/90 - 06/30/93**

This project will provide teacher training in science instruction methods and content for 280 public and private elementary school teachers in the Monongahela Valley (near Pittsburgh, PA). Elementary school teachers will be trained to implement a proven science curriculum package called DASH--Developmental Approaches in Science, Health and Technology--over a 36 month period. DASH was developed by the Curriculum Research and Development Group (CRDG) at the University of Hawaii, and has been successfully piloted by selected laboratory schools and school districts nationally, including two school districts in the Monongahela Valley for two years under the coordinating efforts of the Carnegie Mellon Children's School. These funds will allow us to extend the project to serve a much larger population (39 public schools in 12 districts and 10 Monongahela Valley parochial schools in the Diocese of Pittsburgh).

One of the most important aspects of this proposal is its component of intensive, ongoing, hands-on education of teachers, and selection of highly-qualified and prepared teachers to train other teachers in DASH methods. This will ensure that participating districts will continue to use DASH long after federal funding has expired. The plan of operation features five essential components: promoting awareness; teacher training; follow-up coaching and evaluation; trainer/coordinator training; and producing supplemental materials.

The Carnegie Mellon DASH dissemination group is the largest and most diverse in the nation and serves an urban, industrialized area. The entire nation will benefit from this group's experience in system-wide implementation, which will be carefully studied by local project personnel and CRDG. In addition, the Carnegie Mellon group will be producing supplemental materials to the DASH curriculum that will be transferable to any location in the United States, including an administrator's handbook and take-home newsletters designed to improve family participation in the education of the child. Careful evaluation during and after the 36-month funded phase of the project will show a demonstrable increase in the quantity and quality of science teaching in targeted elementary classrooms, with correlative improvement in student achievement in science.

ABSTRACT

University of California/San Diego

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PROJECT COPE: CHANGE ON PLANET EARTH

Application No:	**R168D 00169**
Amount of Award:	**$150,000**
Budget Period:	**10/01/90 - 12/31/91**
Duration of Project:	**27 months**
Project Period:	**10/01/90 - 12/31/92**

This project forms a partnership among school districts, community resources, and the University of California, San Diego (UCSD) to improve the quality of teaching science at the elementary and middle school levels (K-8) over a two-year period. The overall goal is to improve the science literacy of teachers and students and provide up-to-date resource materials to a wide range of teachers.

The year-long education program will be taught by UCSD scientists/researchers who will write timely and accessible resource materials for dissemination during subsequent inservice programs. The first year consists of ten Saturday seminars involving research scientists, community educators, resource people, and participants in presentations, lab activities and field trips. In year two, the sixty K-8 teachers will then provide inservice programs for at least ten others and thus reach 600 teachers.

This institute model, with its design and writing of materials, a year of education and a follow-up year of implementation, is designed for replication and will be made available to other areas in California where university and school districts have indicated a willingness to engage in such collaboration. Technical assistance will extend well beyond the two-year project suggested here.

ABSTRACT — University of Idaho/Moscow

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IDAHO TRAILS - TOPICALLY RELEVANT APPROACHES FOR INCREASING LEARNING IN SCIENCE

Application No:	**R168D 00409**
Amount of Award:	**$159,861**
Budget Period:	**09/01/90 - 08/31/91**
Duration of Project:	**36 months**
Project Period:	**09/01/90 - 08/31/93**

This project involves eight rural school districts in Idaho to serve as a base from which 16 teachers with leadership potential will be selected to receive training in science content, eight instructional themes, and validated science teaching approaches. This instruction will occur at the University of Idaho. Following the two-week summer experience, the trained mentor teachers will return home empowered to transmit to their colleague teachers the science content and methodologies that they have acquired. To assist in this phase of the project, the mentor teachers will be joined once each month via an appropriate distance learning connection to the campus instructors. At this time a review of the past unit will be made as well as a thorough introduction to the next unit. The units will then be taught to participating teachers' students and evaluated. Participants will be provided appropriate materials to insure hands-on science experiences for their students. The utilization and evaluation of a variety of distance learning approaches appropriate to each school site are an important part of the project. Effective use of available technologies is viewed by school officials as essential in providing in-service to teachers in rural communities throughout Idaho. Concomitant to the project is the formation of community alliances and strong parental involvement. Following the initial year of the project the plan will be implemented in communities contiguous to the original eight districts.

ABSTRACT — Education Development Center

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IMPROVING ELEMENTARY SCIENCE INSTRUCTION PROJECT

Application No:	**R168D 00467**
Amount of Award:	**$165,000**
Budget Period:	**09/01/90 - 08/31/91**
Duration of Project:	**36 months**
Project Period:	**09/01/90 -08/31/93**

The Improving Elementary Science Instruction Project will, over a three-year period:

1. **Train science teacher leaders who will provide site-based science training and leadership;**

2. Conduct awareness and training for all central administration and building administrators to facilitate the advocacy and support necessary to implement a new science approach;

3. Train and enhance the skills of science resource persons to provide staff development, support, networking, resources, and coaching for elementary teachers;

4. Conduct awareness and training activities designed to increase the parent's role in promoting improved science education for their children; and

5. Support the participating schools in developing the capacity to design and implement a school-wide Science Action Plan for inquiry-based hands-on science instruction.

By the end of the final year of the project, the Cleveland Public Schools will have in place a model for implementing staff development for elementary science that will culminate in a Science Action Plan in 42 schools, thereby reaching over 500 teachers and 12,500 students.

Working with the Cleveland Public Schools provides an opportunity to examine in depth the change process required for the system-wide improvement of science curriculum in a system which is firmly committed to decentralization and school based management. It is anticipated that this project will increase the understanding of effective staff development models for enhancing the teaching of science and the successful institutionalization of effective inquiry-based science programs. Of equal importance will be the advancement of the knowledge base required for the implementation of innovation in decentralized school districts.

ABSTRACT

Western Educational Support Team

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FACILITATING ADAPTIVE CURRICULUM: INNOVATION IN SCIENCE EDUCATION (FACITS)

Application No:	R168D 00205
Amount of Award:	$140,000
Budget Period:	10/01/90 - 09/30/91
Duration of Project:	36 months
Project Period:	10/01/90 - 09/30/93

The FACITS Project will serve three main purposes:

1. Provide a structure by which elementary school science materials and resources developed by three exemplary national program may be adapted for use with physically-limited students in special education and mainstreamed classrooms throughout the small-town and rural West.

2. Develop a cadre of 45 master educators to function as Leadership Teachers--persons qualified to lead awareness and staff development activities for local and state peers.

3. Demonstrate a model approach by which needed staff development resources and services may be provided to small-town and rural school personnel in an effective, cost-efficient manner--with emphasis on "distance training" using videotapes and satellite TV broadcasts.

The project will first concentrate on activities in which the directors and training coordinators of the exemplary Informal Science Study, WIZE, and Hands-On Elementary Science programs will work with nationally-known special education experts to adapt their materials and teaching units for use with elementary students with varying types of physical disabilities. Draft versions will be field-tested by exemplary science program trainers during the course of their normal 1990-91 school year staff development activities. After further refinement in June 1991, these materials will be introduced to 45 master educators--Leadership Teacher candidates--from the participating states during a two-week Institute in July 1991. Each Institute participant will then be responsible for implementing one of the three exemplary science programs, as adapted, in his or her own school during the 1991-92 school year.

A second summer Institute in July 1992 will focus on developing participants' leadership skills, preparing them to make awareness presentations for professional groups and lead in-service workshops for local and state colleagues during the 1992-93 school year.

It is projected that a regional audience of 4,500 teachers and other school workers will be served in these workshops, and that benefits will ultimately accrue to an annual audience of 67,500 handicapped and non-handicapped pupils.

Another important project component will be the preparation of three training videos which will be used for both in situ and satellite staff development purposes. Broadcast of these videos has already been arranged with OERI/National Diffusion Network; other regional and national teleconference systems will also be invited to take advantage of these tapes. In addition to their other awareness and in-service activities, the project's 45 Leadership Teachers will be available as downlink site coordinators when the videos are aired.

ABSTRACT

Western Educational Support Team

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PROJECT 4T: TRAINING TEACHERS THROUGH TECHNOLOGY

Application No:	R168D 00204
Amount of Award:	$145,000
Budget Period:	10/01/90 - 09/30/91
Duration of Project:	36 months
Project Period:	10/01/90 - 09/30/93

The 4T project will serve three major purposes:

1. Provide a structure by which materials and resources developed by the exemplary "Hands-On Elementary Science" (HOES) program may be introduced to, and institutionalized in, seventy-five small-town and rural elementary (grades 1-5) classrooms, in fifteen "demonstration schools" in the western states.

2. Develop a cadre of thirty master educators certified to function as Leadership Teachers--personnel fully qualified to lead both awareness and staff development activities for local and state peers.

3. Demonstrate a model approach by which needed staff development resources and services may be provided to small-town and rural school personnel in an effective, cost-efficient manner--with special emphasis on "distance training" using videotapes and satellite TV broadcasts.

The project will first concentrate on activities in which the director and training coordinator of the exemplary Hands-On Elementary Science program will work with selected teachers from western elementary schools to prepare these personnel to serve as state and regional Leadership Teachers. These activities will include both "distance" (video/satellite) and in situ training opportunities.

Another important project component will be the preparation of training videos which will be used both prior to the Institute and subsequently during satellite television broadcasts. Broadcast of these videos has already been arranged with OERI/National Diffusion Network; other regional and national teleconference systems will also be invited to take advantage of the tapes. In addition to their other awareness and in-service activities, the project's Leadership Teachers will be available to service as downlink site coordinators when the videos are aired.

A variety of evaluation strategies are included in the project plan, including the use of 15 State Monitoring Teams and an independent third-party evaluator.

ABSTRACT

Science Education Enhancement Council

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AFTER-SCHOOL HANDS-ON SCIENCE PROGRAM

Application No:	R168D 00452
Amount of Award:	$40,204
Budget Period:	09/01/90 - 08/31/91
Duration of Project:	24 months
Project Period:	09/01/90 - 08/31/92

The after-school hands-on science program in Marshall County, West Virginia is an answer to President Bush's call that American students should be "number 1" in science and mathematics achievements by the year 2000. The nationwide "back to the basics" emphasis in the school curriculum over the past twenty years has often relegated the teaching of science to the background. Further, the textbook-approach is usually preferred over activity-based science due to local curriculum requirements and time limitations during the school hours. This sad status of science is true in Marshall County. The low science scores of the Marshall County students in the Comprehensive Tests of Basic Skills (CTBS) clearly indicate a need for this program.

The Science Education Enhancement Council (SEEC), a non-profit organization, has joined with public and private school officials, teachers, and parents of Marshall County to offer this program to all grades 1-6 students of the community.

The plan of operation has five phases: 1) preparation phase; 2) implementation of the teachers' training workshops; 3) implementation of the program; 4) monitoring; and, 5) evaluation of the program.

The objectives are: 1) train the elementary teachers to do hands-on science activities; 2) provide their teachers with instructional materials for hands-on activities; 3) encourage parents to work with their children's teachers; and, 4) increase the time spent on science.

The program expects the following outcomes: 1) enhance children's understanding of basic scientific knowledge and concepts; 2) improve children's performance on science achievement tests; and, 3) diminish the high rate of science and math avoidance among students.

ABSTRACT

Texas Woman's University

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STRENGTHENING THE EFFECTIVENESS OF ELEMENTARY SCIENCE TEACHING

Application No: R168D 00429
Amount of Award: $160,000
Budget Period: 07/01/90 - 06/30/91
Duration of Project: 24 months
Project Period: 07/01/90 - 06/30/92

Critiques of elementary science education indicate it is woefully inadequate. In fact, most elementary teachers are underprepared to teach science. The goal of this project is to improve the qualifications of elementary science teachers (grades 4 - 6) and their delivery of instruction resulting in improved student learning.

The two-year project has five phases: 1) improving teacher qualifications and preparing instructional units; 2) evaluating classroom instruction and student learning; 3) revising units, enhancing teachers' knowledge, and preparing specific, related inservice; 4) evaluating revised instructional units and student learning programs; and, 5) disseminating project results. Women and minority teachers from inner city, rural, urban, and suburban schools are targeted for inclusion in the project. The existing and State-mandated curriculum is the basis for selecting the program's content.

Teachers' qualifications will be improved as they are immersed in science training which emphasizes concept instruction followed by laboratory activities. Development of critical thinking and problem-solving skills will be integrated throughout. The model classroom environment will foster conceptual understanding and allow time for knowledge restructuring, a necessity since prior misconceptions may interact with accurate concept learning. Teachers will prepare instructional units which are evaluated within a context of both instructional delivery and student learning. Unit revision and further evaluation will complete the cycle.

Bringing about positive change, the intended outcome, is accomplished by building teachers' qualifications and evaluating classroom instruction. These results, shared through conferences and dissemination to school districts, have significance for science educators across the nation.

SECONDARY SCIENCE PROJECTS

ABSTRACT — Baylor College of Medicine

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SCIENCE CURRICULUM REFORM: A WORKING PARADIGM

Application No:	R168D 90125
Amount of Award:	$559,030
Budget Period:	09/01/89 - 08/31/91
Duration of Project:	24 months
Project Period:	09/01/89 - 08/31/91

This 24-month project represents a partnership between a large urban school district, a nationally recognized, science-oriented institution of higher education, and a national professional educational organization for the purpose of establishing a working paradigm for the reform of science education. The project will allow for field testing of a completely revised curriculum, with effort beginning in grade seven and extending over a period of years through grade twelve.

The project focuses on replacing the current layer cake approach to science education, in which courses in major subject areas are taught in sequence from one year to the next, with little attempt to integrate coursework between subject areas. The reformed curriculum will present biology, chemistry, physics, and earth and space science curriculum material in every grade and in an integrated manner that is reinforcing. Seventh and eight grade coursework will focus on descriptive and phenomenological aspects of science. Ninth and tenth grade coursework will introduce the student to empirical and semi-quantitative science. Finally, the last two years of the secondary school curriculum will focus on development of abstract and theoretical scientific learning. The project will emphasize the development in students and teachers of higher-order thinking skills and problem-solving skills that are critical to scientific literacy.

ABSTRACT — American Association of Physics Teachers

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A NATIONAL INTERACTIVE MEDIA PROJECT FOR PHYSICAL SCIENCE COURSES

Application No:	R168D 90059
Amount of Award:	$590,815
Budget Period:	10/01/89 - 09/30/91
Duration of Project:	24 months
Project Period:	10/01/89 - 09/30/91

The project staff and supervisory committees, working through the American Association of Physics Teachers (AAPT) will identify outstanding, archival films for teaching physical sciences courses in secondary schools. These films will be transferred to high quality videotape, carefully edited into short vignettes for classroom use, supported with interactive software lessons, and distributed

nationally in both videotape and videodisc formats accompanied by teachers manuals and diskettes. National, regional, and local teacher training workshops will be held.

The effectiveness and usefulness of these materials will be evaluated by follow-up written and oral interviews of teachers. An indication of the value of the project will be the total number of interactive lessons taught with these materials during the school year of 1991-92.

ABSTRACT

National Science Teachers Association

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DEVELOPING CURRICULUM FOR NEW SCOPE, SEQUENCE, AND COORDINATION OF SECONDARY SCIENCE

Application No:	R168D 90070
Amount of Award:	$70,000
Budget Period:	08/01/90 - 07/31/91
Total Award to Date:	$612,291
Duration of Project:	24 months
Project Period:	08/01/89 - 07/31/91

In an effort to initiate a dramatic improvement in the way science is taught in the United States, this National Science Teachers Association (NSTA) administered program will coordinate a national reform plan to completely reorganize the scope, sequence, and coordination of secondary science courses. The particular focus of the project is to work with pilot centers of reform which include schools that will trial test the new arrangement of science classes; local colleges and universities which will provide the teacher training; and, businesses and industries which will provide some of the scientific expertise and funding to implement the centers.

NSTA, working with content area and learning theory specialists, will redesign and reformat curriculum materials which will coordinate earth and space science, biology, chemistry, and physics to enable them to be taught in varying concentrations in all five years of secondary school - grades 7-12.

ABSTRACT

Sweetwater Union High School District

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THEMATIC INQUIRY

Application No:	R168D 90146
Amount of Award:	$474,153
Budget Period:	08/01/89 - 07/31/91
Duration of Project:	24 months
Project Period:	08/01/89 - 07/31/91

The philosophy of this project is that science must be more accessible and relevant to future citizens so that the power of technology to integrate information can be applied to the challenge of helping students to integrate knowledge and experience. There are major themes in the continuum of scientific disciplines, such as Energy, Evolution, Scale, Systems, Humankind, Matter, and Cycles. Each major theme can

be studied through an independent scientific discipline; for instance, chemistry, astronomy, biology, geology, ecology, etc., or it can be approached on a broader scope of thematic inquiry, discovery, and problem solving. The themes become anchor points in which to tie generalized concepts, methods, and principles of science enabling students to study specific environments and habitats both inside and outside the classroom.

As the students progress through the units, themes are progressively interwoven and expanded to cut across the traditional boundaries of each scientific discipline. Curriculum development is designed to take full advantage of the power of new technologies, improving access to information and representation of information through various delivery platforms and communications modalities.

ABSTRACT

National Audubon Society

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ENVIRONMENTAL SCIENCE INSTITUTE

Application No:	R168D 00151
Amount of Award:	$210,006
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	12 months
Project Period:	07/01/90 - 06/30/91

The National Audubon Society has developed a national strategy for working with inner city school systems to integrate issues of environmental hazards into science education. In 1989 Audubon joined forces with the District of Columbia Public Schools to create a model teacher training program for integrating environmental issues into the middle school/junior high school science curriculum. This proposal will capitalize on the seminal work of the National Audubon Society/District of Columbia Public Schools Science Institute. It will bring a process, materials, teacher training, and state-of-the-art technology in environmental science to public and private schools serving minority group students across the country.

During the project period the Audubon will:

- Implement Audubon Science Institutes at five school sites serving minority students.
- Design training manuals and materials for participants and trainers based on an interdisciplinary environmental science theme curriculum and a technology-based instructional delivery system.
- Adapt the finely crafted and nationally acclaimed Audubon print materials, computer software, videos, and videodisc materials for middle school science instruction.
- Train a corps of 20 middle school science and mathematics teachers largely from minority groups to serve as certified Audubon Science Institute trainers.
- Conduct a minimum of 10 teacher training workshops in school districts serving predominately minority group students.
- Conduct a feasibility study for implementing the Environmental Issues/Audubon Science Institutes nationally.

ENVIRONMENTAL SCIENCE INSTITUTE (continued)

- Plan a national dissemination conference for educators, community leaders, political leaders, and environmental advocates to publicize the objectives, materials, teacher training activities, and materials developed by the National Audubon Society.

This proposal closely identifies the Audubon Science Institute (ASI) with the science-technology-society movement, which seeks to teach science in the context of technology and society. Audubon hopes to replicate the ASI concept in school districts across the country. They will make Audubon resources available to schools participating in this project and will assist in locating other financial resources for the continuation and expansion of the Science Institutes.

ABSTRACT

Lewisville Independent School District

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TECHNOLOGY-BASED SCIENCE INSTRUCTION

Application No:	R168D 00047
Amount of Award:	$180,558
Budget Period:	08/01/90 - 07/31/91
Duration of Project:	24 months
Project Period:	08/01/90 - 07/31/92

The project is focused around five objectives and activities:

1. Increasing student mastery of physical science concepts;
2. Increasing teacher confidence and competence at incorporating technology-base curriculum into the science classroom;
3. Addressing special learning needs of students identified as at-risk due to academic, economic, cultural or social disadvantage;
4. Increasing student interest in taking additional science courses; and
5. Increasing teacher usage of questioning techniques that encourage higher level thinking.

Lewisville Independent School District (LISD) will adapt, supplement and implement the TLTG Interactive Videodisc Physical Science Program on a district-wide basis. While the TLTG program will be a primary vehicle in the project, a major emphasis will be placed on adaptations to meet special learning needs, supplementations to broaden the delivery system (networking to a file server, LCD computer-generated overhead projection, use of archival videodisc programs), special teacher training (learning styles, concept mapping, TESA, questioning techniques), peer observation for teachers, and peer tutoring for students.

The project will combine an established technology-based physical science program with other technology delivery systems, recognized motivational programs, and additional content and pedagogical training. The project also tests specific activities intended to increase student enrollment in additional science classes. The project is structured to maximize dissemination and potential replication: organized curriculum guides and reports; support of organizations with local, regional, state and national lines of dissemination; willingness to serve as a demonstration site; placing pre-service teachers from five large universities in a technology-based science setting; and intent to present findings in professional journals and meetings.

ABSTRACT

Bronx High School of Science Foundation

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A MODEL PROJECT TO ESTABLISH A LOCAL, REGIONAL AND NATIONAL APPROACH TO THE ENHANCEMENT OF SCIENCE TEACHING

Application No:	R168D 00373
Amount of Award:	$180,000
Budget Period:	09/01/90 - 08/31/91
Duration of Project:	36 months
Project Period:	09/01/90 - 08/31/93

Staff at the Bronx High School of Science have long felt that scientific creativity can, in fact, be stimulated by the educational process. The school's three-year sequence in the sciences has consistently been successful in turning out student researchers who have been prizewinners in the Westinghouse Science Talent Search as well as in numerous other competitions. On a broader level, students who go through the program develop the type of questioning and thinking skills that will allow them to become productive members of society in general and the scientific community in particular.

Critical to achieving this goal is the performance of the classroom teacher in the educational process. This program will establish a teacher-training center within the science departments at The Bronx High School of Science that will provide the opportunity for teachers from both public and private schools to develop the philosophy, strategies, and techniques necessary to build problem-solving skills and creativity on the part of their students. In essence, The Bronx High School of Science will serve as a regional center for the development of a nationwide network of teacher training centers for inner city, suburban and rural school districts. Specific goals, over the three years of this project are to enhance science teaching for approximately 200 local teachers and to establish from 20-25 regional centers which can then perpetuate this project nationwide. The impact of this training program on the teacher-participants will be evaluated.

ABSTRACT

Bank Street College of Education

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HUDSONWATCH INSTITUTE PART II

Application No:	R168D 00025
Amount of Award:	$170,000
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	24 months
Project Period:	07/01/90 - 06/30/92

At the summer Hudsonwatch Institute, Bank Street faculty, research scientists, and groups of twenty teachers who work with early adolescents will spend twelve days over four weeks in a professional development experience that focuses on "science-through-inquiry" as a way of encouraging the interest and literacy level of young adolescent students. After the Institute, Bank Street College will monitor and

transfer the approach to the classroom by the Institute participants, document and evaluate the translation of the summer experiences into classroom curriculum, and disseminate that curriculum through the national network of teacher centers.

The expected outcome of the project is to create a model science education program for teachers of early adolescents that addresses four critical needs:

- The need of teachers to experience what scientific investigation really is, beyond the mandated "hands-on approach."
- The need of teachers to understand science in its proper social context--to think about science in the web of human experience--and thus to understand how children's studies of science intersect with their studies of other bodies of knowledge.
- The need for interaction among scientists, teachers and science educators.
- The need for a support group as teachers adopt new approaches to the work in their classrooms.

ABSTRACT

Maryland State Department of Education
Maryland Instructional Technology (INTEC)

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STARFINDER: THE HUBBLE SPACE TELESCOPE

Application No:	R168D 00349
Amount of Award:	$235,000
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	12 months
Project Period:	07/01/90 - 06/30/91

Maryland Instructional Technology (INTEC), a Division of the Maryland State Department of Education will develop a series of 30 fifteen-minute instructional videotapes, accompanied by teacher's guides for use in the junior high and high schools across the United States. The motivation for the series will come from the Hubble Space Telescope and the Space Telescope Science Institute. The Hubble Space Telescope will offer us a chance to move forward in space science and can serve as a motivator for students to learn science concepts. The series will be broadcast over the Public Broadcasting Service (PBS) network and offered on videocassettes to schools not part of the network and without satellite dishes.

The project will design, write, and produce a series of instructional videotapes and design and write related teacher's guides. The project will be developed by INTEC staff in consultation with an advisory panel including representatives from eleven states and the Space Telescope Science Institute. Once the products are complete, the print material will be sent to participating institutions for duplication and dissemination and the instructional videos will be broadcasted through the PBS network for recording and rebroadcasting or use to fit the needs of particular participating institutions and organizations.

The video series is intended to disseminate in a timely way to teachers and students the discoveries of the Hubble Space Telescope; to make available to all science teachers across the nation a visual explanation of 30 physical and earth science concepts suitable for inclusion into the curriculum; to offer a set of print materials that emphasize hands-on experiences; and to make available to students personal conversations with individuals involved in the Space Telescope Science Institute.

ABSTRACT

Columbia Education Center

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TEPE: TEACHER ENHANCEMENT FOR PHYSICS EDUCATION

Application No:	R168D 00335
Amount of Award:	$155,000
Budget Period:	10/01/90 - 09/30/91
Duration of Project:	36 months
Project Period:	10/01/90 - 09/30/93

The TEPE project will serve three major purposes:

1. Provide a structure by which materials and resources developed by three exemplary high school physics programs may be introduced to and institutionalized in classrooms in 45 small-town and rural "demonstration schools" in the West.

2. Develop a cadre of 45 master educators certified to function as Leadership Teachers--personnel fully qualified to lead both awareness and staff development activities for local and state peers.

3. Demonstrate a model approach by which needed staff development resources and services may be provided to small-town and rural school personnel in an effective, cost-efficient manner--with special emphasis on distance training using videotapes.

TEPE will offer activities in which the directors of three exemplary National Diffusion Network (NDN) programs work with western educators to prepare these personnel to serve as Leadership Teachers. The NDN programs are *PRISMS, Physics: Teach to Learn*, and *Mechanical Universe*. The project membership will be divided into three fifteen-person groups, one group for each of the three programs.

After a video orientation and "sampler" field testing activities during the second half of the 1990-91 school year, Leadership Teacher candidates will attend a two-week Institute in Salem, Oregon, July 1991. This Institute will concentrate on the operational specifics of the three exemplary programs and, to a degree, the use of technological systems for teacher training and direct classroom instruction purposes. After the Institute, participants will be responsible for conducting full-scale implementations during the 1991-92 academic year.

A one-week Institute in July 1992 will focus on developing participants leadership skills, preparing them to make awareness presentations for professional groups and lead in-service workshops for local and state colleagues during (and after) the 1992-93 school year.

Another important project component will be the preparation of "sampler" videos which will be used both prior to the first Institute and subsequently during satellite television broadcasts. Broadcast of these videos has already been arranged with OERI/National Diffusion Network; other regional and national teleconference systems will also be invited to take advantage of the tapes. In addition to their other awareness and in-service activities, the project's Leadership Teachers will be available to serve as downlink site coordinators when the videos are aired.

A variety of evaluation strategies are included in the project plan, including the use of State Monitoring Teams and a third-party evaluator.

OTHER SCIENCE AND MATHEMATICS PROJECTS

ABSTRACT — Oklahoma School of Science and Mathematics

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CURRICULUM DEVELOPMENT PROJECT FOR THE SCHOOL OF SCIENCE AND MATHEMATICS

Application No:	R168D 9033
Amount of Award:	$600,000
Budget Period:	09/01/89 - 08/31/91
Duration of Project:	24 months
Project Period:	09/01/89 - 08/31/91

The purpose of this project is designed to demonstrate the effectiveness of a model curriculum to meet the instructional needs of gifted high school students in science, mathematics, and technology. A model research-oriented curriculum in the fields of science, mathematics, and technology will be developed, tested, and disseminated. The model, to be based upon Bloom's taxonomy of learning, will be implemented through small-group or individualized instruction, on-campus research projects, and off-campus research in conjunction with a mentor. Over 300 individuals from universities and industry have volunteered to serve as mentors.

The curriculum will be developed during the first year of the project and tested during the second year. The school will serve as a site for teacher training; in addition, statewide dissemination of the curriculum is planned to improve teaching methods in the three academic fields. National dissemination of the project will be accomplished through presentations at educational conferences, publication of articles, and application to the National Diffusion Network for status as a validated program.

ABSTRACT — Educational Testing Service

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SYSTEM THINKING AND CURRICULUM INNOVATION NETWORK HIGH SCHOOL MATHEMATICS AND SCIENCE

Application No:	R168D 90006
Amount of Award:	$535,687
Budget Period:	10/01/89 - 09/30/91
Duration of Project:	24 months
Project Period:	10/01/89 - 09/30/91

This project will provide support to enable twenty-four teachers of science and mathematics in seven schools in California and Vermont to develop curriculum materials and instructional strategies for the systems thinking approach. The project will offer new methods of inservice programs to assist teachers to develop, apply, and infuse the innovative technology-based instructional perspective of systems thinking into existing curricula. The curriculum materials produced in content-specific teacher networks will be disseminated for use by other teachers in the project schools, and eventually to other locations where the model for teaching with systems thinking will be implemented.

These goals will be accomplished through intensive teacher preparation inservice settings and interactions with networks of systems experts, mathematics and science educators, curriculum specialists, and other teachers.

ABSTRACT — Michigan Technology Council

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IMPROVING QUALITY OF TEACHING AND LEARNING IN MATHEMATICS, SCIENCE, AND COMPUTER LEARNING THROUGH THE COOPERATION OF RCTC AND MTC

Application No:	R168D 90088
Amount of Award:	$386,652
Budget Period:	09/01/89 - 08/31/91
Duration of Project:	24 months
Project Period:	09/01/89 - 08/31/91

A collaboration between the Michigan Technology Council (MTC) and the Ypsilanti Public Schools will establish a business, industry, and education partnership in Washtenaw County to educate teachers and students in a working application of math, science, technology, and communication skills.

The first part of the project, the MTC Quest Program, regularly exposes teachers and students to business experiences with the latest technologies. In part two of the project, designed by the Ypsilanti Public Schools under the guidance of the Regional Career Technical Center (RCTC), curriculum modules will be developed over a two year period and made available for use throughout Washtenaw County.

ABSTRACT — Comanche County Board of Education

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CONSOLIDATION BY COMMUNICATION FOR MATHEMATICS AND SCIENCE REFORM

Application No:	R168D 90055
Amount of Award:	$538,245
Budget Period:	10/01/89 - 09/30/91
Duration of Project:	24 months
Project Period:	10/01/89 - 09/30/91

Our aim is to improve the opportunity for access to updated, quality instruction in mathematics and science for students in ten small, isolated rural school districts in Southwest Kansas. To attain this goal, the participating schools and cooperating colleges, universities and private agencies will consolidate by communication. using the instructional resources of ten small rural isolated school districts in southwestern Kansas and incorporating full motion-analog television for instructional delivery. Next, the project will upgrade and strengthen the mathematics curriculum available in the secondary schools to include four years of mathematics and opportunity for advanced placement in mathematics at all high schools in the consortium in accordance with National Council of Teachers of Mathematics recommendations. There also will be an upgrading and strengthening of the science and technology curriculum for grades 9-12 to include four years of science with a strong focus upon laboratory activities and the use of extensive computer simulation in all subjects, and advanced placement opportunities at all schools. Finally, plans will be developed for vertical integration of the educational opportunities found in the ten school districts with two or more community colleges and at least one comprehensive state-supported university as a means of facilitating programs of advanced placement for school students, and adult or continuing education for professionals including teachers and school administrators.

ABSTRACT — Mid-Continent Regional Education Laboratory

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RURAL SCIENCE AND MATH HIGH SCHOOL WITHOUT WALLS

Application No:	**R168D 90013**
Amount of Award:	**$485,494**
Budget Period:	**10/01/89 - 09/30/91**
Duration of Project:	**24 months**
Project Period:	**10/01/89 - 09/30/91**

Using technology partnerships among rural and small schools, universities, State Departments of Education, and public and private resource agencies, this project seeks to reform teaching in three ways. First, the project will expand the science. mathematics and technology course offerings available to students attending rural high school; secondly, it will provide access to content specialists; and, thirdly, provides on-going professional development opportunities for teachers in rural schools.

The Rural Science and Mathematics High School Without Walls uses existing higher education staff to assist with advanced courses. The delivery of instruction includes a combination of campus institutes, local seminars of students from neighboring schools, and electronic networking using affordable technology. The basic structure is a cluster of school districts networked with an institution of higher education.

ABSTRACT — American Samoa Government

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(684) 633-5237

SAMI: SCIENCE AND MATH IMPROVEMENT PROJECT

Application No:	**R168A 90376**
Amount of Award:	**$60,000**
Budget Period:	**10/01/90 - 09/30/91**
Total Award to Date:	**$169,505**
Duration of Project:	**36 months**
Project Period:	

The "SAMI" (s-ah-me) project seeks to improve science and mathematics instruction in elementary schools in American Samoa by training and motivating teachers and developing peer support teams in all participating schools. Teacher workshops spanning a two year period will focus on the attitudes, knowledge, and skills needed to implement instructional improvement. Annual science and mathematics instructional conventions will be planned for teachers. A growing team of support teachers will be developed throughout the three year cycle to sustain the program's activities and to further act as a model for isolated, rural school districts.

ABSTRACT — Northwest Regional Educational Laboratory

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THE SMART PROJECT:
SCIENCE AND MATHEMATICS ACADEMIES FOR RURAL TEACHERS

Application No:	**R168D 00183**
Amount of Award:	**$250,000**
Budget Period:	**08/01/90 - 07/31/91**
Duration of Project:	**36 months**
Project Period:	**08/01/90 - 07/31/93**

The SMART Project is a regional capacity building alliance of Pacific Northwest teacher educators who have a demonstrated commitment to improving the quality of mathematics and science instruction in small, rural schools through teacher preservice, induction and inservice.

Ten teacher education institutions in the Northwest will form an alliance to strengthen the quality of mathematics and science instruction in rural schools through regional and state-level summer academies over the next three years. Fifty master teachers of mathematics and science will form a leadership cadre to supervise student teachers in rural settings and serve as mentor teachers for new staff.

The significant outcomes will be five-fold:

1. **Increase recognition and incentives for veteran teachers of mathematics and science in economically disadvantaged small, rural schools;**

2. **Increase the quality and number of field practicum placements in small, rural schools of prospective mathematics and science teachers;**

3. **Increase the quality of teacher induction in small, rural schools;**

4. **Enhance the range of instructional strategies introduced in mathematics and science teacher education appropriate to small, rural schools; and,**

5. **Demonstrate the generalizability and effectiveness of regional alliances of higher education institutions and science-technology centers for improving the quality of educational opportunities for students and teachers.**

ABSTRACT — Colorado Partnership for Educational Renewal

Contact Person: Carol Wilson
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COLORADO PARTNERSHIP MATHEMATICS PROJECT

Application No:	**R168D 00328**
Amount of Award:	**$150,000**
Budget Period:	**10/01/90 - 09/30/91**
Duration of Project:	**36 months**
Project Period:	**10/01/90 - 09/30/93**

The Colorado Partnership Mathematics Project (CPMP) will reform mathematics education in elementary and secondary schools in the five Partnership school districts. Reform will be addressed through the process of collaborative inquiry which involves teachers in developing the habit of examining what they do and why they do it, and continually seeking new knowledge about mathematics education in a supportive, collegial environment. Drawing on ideas, principles, and recommendation in current research, the CPMP will address teacher knowledge of mathematics, instructional practices, and the process of change. The project will:

1. Expand the mathematical knowledge base of teachers;

2. Expand teachers' use of instructional strategies for engaging students in active learning and problem solving;

3. Develop a cadre of lead teachers who will continue to serve as change agents in the reform of mathematics education;

4. Develop a set of guidelines for conducting collaborative inquiry that focuses on mathematics education; and

5. Improve student attitudes toward mathematics.

Ten schools across five districts will become centers of collaborative inquiry and models of exemplary mathematics teaching. Lead teachers and lead support teachers from each of the schools will be identified to work with their colleagues in intensive ways that support ongoing growth in understanding and teaching of mathematics. These teachers will be supported by district mathematics supervisors and educators, mathematicians from the three higher education institutions, and Partnership staff.

The schools will become centers of mathematical inquiry charged with disseminating and networking the principles and processes of the project in the additional 227 schools of the Partnership and the three teacher education programs. The CPMP will also link with other mathematics reform efforts through the 14-state National Network for Educational Renewal.

ABSTRACT

GMI Engineering and Management Institute

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TUNE IN TO MATH AND SCIENCE

Application No:	**R168D 00225**
Amount of Award:	**$376,250**
Budget Period:	**08/01/90 - 07/31/91**
Duration of Project:	**12 months**
Project Period:	**08/01/90 - 07/31/91**

This is a collaborative project involving higher education, urban school districts, corporate employers, organized labor, professional societies, foundations and state and federal government. It is building upon a $1 million dollar pilot science and mathematics project currently being implemented in five predominantly minority school districts at the middle school and early high school levels with immediate plans to include upper elementary.

The project employs cutting edge technology, NSF sponsored and validated curricula, highly selected master teachers, model staff development techniques, corporate mentors, parent participation and supportive community intervention to excite, motivate, teach and support students and teachers, especially in urban school districts.

Currently funded by corporate, NSF, foundation, labor and state sources, with extraordinary infusion of in-kind support, the project will expand within the pilot school districts and to at least five additional large urban districts in at least three states, as it continues to assess its progress against the NCTM standards and the AAAS Project 2061 and to pursue serious inquiries to collaborate and expand nationally.

GMI Engineering and Management Institute has borne the financial risk of the pilot project to demonstrate the efficacy of the program as a response to the MIT Commission on Industrial Productivity treatise, Made in America, and as a necessary prelude to a full year project in a multistate region. It is intended that GMI's corporate partners, acting out of enlightened self interest will become the primary advocates and catalysts for the program in their respective communities.

ABSTRACT SUNY Research Foundation/College at Cortland

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AN INTERDISCIPLINARY TEACHING MODEL TO ENHANCE ACHIEVEMENT OF ELEMENTARY STUDENTS IN SCIENCE AND MATHEMATICS

Application No:	R168D 00439
Amount of Award:	$89,411
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	24 months
Project Period:	07/01/90 - 06/30/92

The project is designed to enhance elementary student (4th-6th grades) attitude toward and achievement in science and mathematics through an interdisciplinary curriculum which focuses on real world problems. This is to be accomplished through a teacher enhancement program and an academic year support program which facilitates program implementation, promotes parent involvement and utilizes a multi-faceted student assessment plan.

Teams of four intermediate level teachers from eight elementary buildings will participate in the project. Participating schools are located within a 60-mile radius of Cortland and will be equally divided between rural and inner city populations.

The eight-teacher teams will participate in an intensive two-week summer institute to be held on the SUNY College at Cortland campus during August, 1990. During the Institute teachers will explore the curricular linkages between science and mathematics which can be nurtured to make instruction in both disciplines more meaningful and relevant to students. The teachers will participate in a hands-on model unit which integrates Level III understandings on the Ecosystem (NYS Elementary Science Syllabus) and Geometry and Measurement standards (NYS Elementary Mathematics Syllabus and NCTM Standards). During the Institute, teacher teams will prepare parent involvement and student assessment plans.

During the academic year, 1990-91, the project staff will serve as consulting teachers for the participating teams. Consulting teachers will serve as co-teachers, help implement the interdisciplinary unit, "Geometry and Measurement in the Environment," support the development of a second interdisciplinary unit, and aid in implementing the parent involvement and the student assessment plan. Each participating teacher will be visited eight times during the academic year.

Assessment of project results will be measured by pre- and post-attitude surveys administered to students, teachers and parents; scores on PEP and ASPET tests; teacher journals and student portfolios.

ABSTRACT

Ramapo College of New Jersey/Mahwah

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PROJECT WHY

Application No:	R168D 00173
Amount of Award:	$170,000
Budget Period:	08/01/90 - 07/31/91
Duration of Project:	36 months
Project Period:	08/01/90 - 07/31/93

Project Why is a collaborative endeavor between Ramapo College of New Jersey, a four-year undergraduate liberal arts State College, the Englewood Public Schools, and Corn Products Company International (CPC). Parents, teachers, administrators, college faculty and CPC professionals will work together to improve mathematics and science teaching and instruction in grades pre-K to 7, by: (1) improving teacher attitudes toward the subjects and toward the teaching of them. (2) improving teacher knowledge of content and methodology, (3) improving teacher instructional effectiveness, (4) increasing the quantity of mathematics and science instructional time, (5) improving student attitudes toward the study of mathematics and science; and improving student achievement.

These objectives will be achieved through intensive in-service teacher training during the school year and during two weeks in the Summer of 1991. Concurrently, adequate and effective support services for students and teachers will be collaboratively designed and implemented.

Project Why will develop confidence in teachers which will result in improved instruction, increased instruction, improved student attitudes and improved student achievement. Ultimately, better student achievement and attitudes at the elementary level will result in raised expectations, a strengthened and enriched curriculum and improved success on the secondary level and beyond.

ABSTRACT — Southwest Educational Development Laboratory

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PASO PARTNERS PROJECT

Application No:	**R168D 00166**
Amount of Award:	**$181,365**
Budget Period:	**09/01/90 - 08/31/91**
Duration of Project:	**36 months**
Project Period:	**09/01/90 - 08/31/93**

Southwest Educational Development Laboratory (SEDL) has organized the Paso Partners--a partnership of three public school districts, two institutions of higher education, and staff from SEDL's Follow Through Program-to mount a coordinated assault on the problems of poor mathematics and science achievement among limited-English-proficient (LEP) Hispanic students in kindergarten through the third grade.

Among the nation's 42 million school children, some 1.5 million are in LEP programs. The majority of these are Hispanic. These students have the special problem of learning not only science and mathematics but also a new language at the same time. SEDL's 21-year-old Follow Through Model is a language-development approach for organizing and conducting instruction and parent involvement to foster not only English-language skills but also academic skills and foundations in core subject areas. The Paso partners Project will combine this proven Follow Through Model with the best emerging strategies and materials for teaching mathematics and science and will train teachers (including inservice teachers, teacher aide interns, and student teachers) and provide technical assistance to help them implement the strategies in up to 33 classrooms in three poor, primarily Hispanic school districts on the U. S./Mexico border near El Paso, Texas.

The outcome of this work--as a three-year project--will be educational impacts on some 840 LEP children, an array of education professionals trained and equipped to continue the strategies with similar children for years to come; model curriculum guides developed by the teachers for kindergarten through third grade; and regional and national exposure of the project and its effects through professional presentations, a regional dissemination conference, and integration of the concepts into other federally funded service projects at SEDL for bilingual education programs.

ABSTRACT — Rochester City School District

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SCIENCE/MATH DEMONSTRATION MODEL WHICH OFFERS TEACHING TRAINING, RESOURCES AND INSTRUCTIONAL SUPPORT IN SCIENCE AND MATH

Application No:	**R168D 00104**
Amount of Award:	**$140,000**
Budget Period:	**09/01/90 - 08/31/91**
Duration of Project:	**36 months**
Project Period:	**09/01/90 - 08/31/93**

Using elementary School No. 12 as a demonstration site, the District will implement a model elementary science center operated by a certified elementary teacher with the assistance of a part-time scientist as well as part-time clerical staff. The James P.B. Duffy School No. 12 enrolls 912 students. Sixty-five percent of the students are minority students. This demonstration model will be developed, implemented and evaluated over a three-year period, thereby allowing adequate time for full program implementation, assessment, and for District-wide implementation once the program has been fully tested at the demonstration site.

The Science Connection Center, as the focal point of science education for the school, will provide all classroom teachers with a variety of support activities. For all participating teachers, the program will result in improved proficiency in knowledge and skills in the teaching of science and math as well as a positive attitude toward science and math. Consequently, the most important objective is to achieve improvement in the knowledge, the skills, and the attitudes and abilities in science and math for the elementary students in the system.

Key components of the Science Connection Program include teacher training, instructional support for science lesson guides, team teaching with a scientist, science materials for hands-on activities, transportable science equipment and materials, and science/math resource materials and special activities and events.

ABSTRACT

University of North Florida/Jacksonville

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PROJECT BEAM - BOOSTING EDUCATION AWARENESS IN MINORITIES

Application No:	R168D 00090
Amount of Award:	$120,115
Budget Period:	09/01/90 - 08/31/91
Duration of Project:	36 months
Project Period:	09/01/90 - 08/31/93

Project BEAM is directed toward capable secondary school minority students who have not selected college preparatory programs. It seeks to provide them with the necessary background, through specialized summer mathematics and science coursework, so that by graduation they will be as well prepared as those who began the college track earlier.

Sixty ninth-grade minority students from high schools in Duval County, Florida. with identified potential for college but who have not selected college track coursework will be selected to participate in specially developed coursework in mathematics and science during the summers following their 9th, 10th, and 11th grades. To alleviate their need for summer employment, modest stipends will be paid for their participation in the six-week special summer sessions. Students who succeed in all three summer sessions and graduate within the following year will be assured of admission as freshmen into the University of North Florida (UNF) upon graduation.

Teams of UNF mathematics, science, and education faculty will work with master teachers from Duval County during the academic year to develop the special courses. The master teachers will deliver the courses on the UNF campus. Teacher education students from UNF will serve pre-internships in these summer programs and thereby gain experience in the special educational needs of these minority students.

ABSTRACT

American Association for
the Advancement of Science

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PROYECTO FUTURO - IMPROVING ELEMENTARY AND MIDDLE SCHOOL SCIENCE AND MATHEMATICS EDUCATION FOR HISPANIC CHILDREN

Application No:	**R168D 00110**
Amount of Award:	**$160,000**
Budget Period:	**09/01/90 - 08/31/91**
Duration of Project:	**24 months**
Project Period:	**09/01/90 - 08/31/92**

Proyecto Futuro is designed to mobilize the Hispanic community to work in partnership with schools to improve science and mathematics teaching and learning. Project goals include:

- Developing and cultivating a coalition of local school councils, principals, teachers and parents;
- Developing materials that facilitate a hands-on/inquiry/problem-solving approach within the curriculum framework mandated by local and state guidelines and materials that are culturally-relevant for Hispanics;
- Providing training, technical support and resources to implement instructional strategies that incorporate scientific process skills and culturally-related activities; and
- Providing parents with specific strategies for encouraging children in mathematics and science.

Project sites include 10 schools in the Chicago area with high populations of Hispanic students. Community groups involved in the project include the Hispanic Alliance for Career Enhancement, ASPIRA, LULAC National Educational Service Center, El Hogar del Nino, Association House, and the Society for Hispanic Professional Engineers. Products developed will include a teacher guide on science and mathematics instructional strategies for use with Hispanic students. Materials developed will be disseminated by AAAS and national Hispanic community-based organizations.

ABSTRACT

University of North Carolina at Chapel Hill

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STATEWIDE IMPROVEMENT IN ELEMENTARY MATHEMATICS AND SCIENCE INSTRUCTION THROUGH PEER TEACHER TRAINING

Application No:	**R168D 00258**
Amount of Award:	**$350,000**
Budget Period:	**08/01/90 - 07/31/91**
Duration of Project:	**36 months**
Project Period:	**08/01/90 - 07/31/93**

This three-year project is an extension of a very successful pilot project recently completed by the Mathematics and Science Education Network in North Carolina. The project design includes a leadership development/peer training/school-based planning model in which two lead teachers and a principal from 12 elementary schools at each of 10 sites (240 teachers and 120 principals in each of two years) will conduct school assessments and produce plans for improving either mathematics or science education at their schools. Lead teachers will receive training from University faculty and master teachers to assist them in becoming peer teachers; the school assessment and subsequent training will focus on meeting the new professional standards at the elementary level. During subsequent years, lead teachers will train their colleagues and implement plans for improving mathematics or science instruction at their schools. Selection of participating schools will focus on reaching the traditionally underserved--i.e., schools with high minority populations, schools in economically depressed areas, and schools in remote rural areas. Throughout the project, outcomes will be documented, and results will be widely disseminated.

The project will make a significant impact on the quality of mathematics and science instruction by providing training for the entire faculties at 240 historically underserved elementary schools. In addition, the program will serve as a model for statewide school improvement that can be replicated throughout the nation.

ABSTRACT

Diocese of Fargo

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IMPROVING THE QUALITY OF TEACHING AND LEARNING THROUGH SATELLITE DISTANCE LEARNING

Application No:	R168D 00054
Amount of Award:	$113,400
Budget Period:	10/01/90 - 09/30/91
Duration of Project:	36 months
Project Period:	10/01/90 - 09/30/93

Utilizing satellite interactive distance learning, this project will provide expanded opportunities for improved curricula in mathematics and science for elementary and secondary students and classroom teachers.

The three year, system-wide curriculum improvement project will implement new math and science curriculum into 13 private schools in eight towns and cities in the eastern half of North Dakota. These schools comprise the Diocese of Fargo school district.

The project is based on a downlink from a validated satellite interactive distance learning program that will provide: 1) enrichment programs in mathematics and science for elementary and junior high students, 2) expanded course selections (with college credit options) in mathematics and science for high school students, and 3) in-service opportunities for teachers, administrators and support staff to improve the quality of teaching and instruction in mathematics and science.

During each of the three years, an evaluation will be conducted to assess the impact of satellite interactive distance learning on teaching and learning, particularly as it affects students' knowledge, attitude, behavior and opportunity, and teachers' professional development and use of instructional strategies.

ABSTRACT Educational Service District #101

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GEMS BY SATELLITE: AN INNOVATIVE MODEL FOR ACTIVITY-BASED SCIENCE IN-SERVICE VIA SATELLITE

Application No:	R168D 00040
Amount of Award:	$220,000
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	24 months
Project Period:	07/01/90 - 06/30/92

"GEMS by Satellite" will use satellite technology to provide public and private rural schools in Alaska, Idaho, Montana, Oregon and Washington an opportunity to improve K-8 science instruction through an in-service model designed to lead to systematic district or building implementation. Despite the distances between participating schools and their teachers, this model maintains the interactivity of an on-site, hands-on in-service model. This model also involves administrators, parents and community members to provide a broader base of support for necessary changes.

Great Explorations in Math & Science (GEMS), developed at the Lawrence Hall of Science, is an exciting and effective curriculum and in-service program that has been tested by hundreds of teachers nationwide. The GEMS curriculum was selected by the National Science Foundation for wide scale national dissemination. Through the NSF funded project, staff from the Lawrence Hall are working with 2,000 educators. This distance learning program will make GEMS available to teachers in rural areas who do not currently have access to the GEMS Nationwide Network.

The project will use a premier distance learning program, Educational Service District 101's Satellite Telecommunications Educational Programming (STEP), to bring live, interactive science in-service to 60 remote school districts in the five designated states. The design, production and broadcasting of "GEMS by Satellite" will result in 'live-to-tape' and video segments which will be edited into a GEMS training package consisting of 13 two-hour videotapes for use by the Lawrence Hall of Science in its efforts to continue disseminating GEMS as NSF funding expires. Furthermore, with the initial costs of design and preproduction removed, satellite technology provides an economical way of reaching increasing numbers of school districts with satellite dishes. In other words, the "GEMS by Satellite" program will continue to be offered to school districts without the need of additional support.

ABSTRACT University of Miami

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MSRT: MATHEMATICS AND SCIENCE RESOURCE TEACHER PROJECT

Application No:	R168D 00102
Amount of Award:	$138,349
Budget Period:	08/15/90 - 08/14/91
Duration of Project:	36 months
Project Period:	08/15/90 - 08/14/93

Recent national reports in education have highlighted the need for reform in curriculum, teacher education, and student assessment practices. A gap exists between these global recommendations and what is specifically needed to accomplish the national objectives. The proposed project addresses one particular aspect of the national call for reform: improvement of staff development in mathematics and science. The overall purpose of the Mathematics and Science Resource Teacher Project is to improve the quality of mathematics and science instruction and teachers at the elementary level, in order to facilitate the access of elementary school students who have been underserved and underrepresented in mathematics and science education. The specific objectives of the program are:

1. Implement a staff development model which emphasizes: a) upgrading content knowledge of mathematics and science teachers, b) development of instructional skills consistent with the recommendations of recent national reports, c) development of leadership skills for teachers to serve as resource and staff development facilitators for colleagues, and d) institutionalization of the program at the University of Miami.

2. Evaluate the implementation of the model with a group of inner-city teachers of a large metropolitan school district.

3. Develop materials for national distribution to be used by districts in the replication/adaptation of the program.

4. Disseminate project materials and conduct staff development workshops at regional, state and local levels during the last year of the project.

The project will involve 40 elementary school teachers divided evenly between teachers from predominantly Hispanic and Black enrollment schools. Upon successful completion of the project, teachers will receive a specialist degree in mathematics and science education.

ABSTRACT

The Exploratorium

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THE EXPLORATORIUM AS A COMMUNITY-BASED SCIENCE AND MATHEMATICS TEACHER ENHANCEMENT RESOURCE

Application No:	R168D 00310
Amount of Award:	$140,076
Budget Period:	07/01/90 - 06/30/91
Duration of Project:	18 months
Project Period:	07/01/90 - 12/30/91

The Exploratorium has two teacher enhancement programs: the School in the Exploratorium, which serves K-6 teachers, and the Exploratorium Teacher Institute. which serves middle and high school teachers. The program will focus the activities on Chapter 1 schools in the San Francisco Unified School District.

In San Francisco, the percentage of Chapter 1 schools is extremely high. and with the city's diversified ethnic and racial mix, the already widespread problem of sparking students' interest in science and mathematics is complicated by cultural and linguistic obstacles. Generally speaking, and through no fault of their own. teachers at the elementary, middle, and high school levels have been inadequately trained in methods of teaching science to their classes. Faced with concerns about providing "science literacy" and the increased pressure to follow demanding new curricula, many teachers have felt demoralized and unsupported. The Exploratorium's teaching programs have been developed so that staff will work continuously with teachers at all levels to give them both the self-confidence and the practical skills that will allow them to communicate to their students that science and mathematics can be fun and personally meaningful.

The main objective is to develop a "critical mass" of teachers trained in activity-based science teaching by concentrating on Chapter 1 schools in San Francisco through intensive 80-100 hour workshops and follow-up activities based on successful models developed with NSF and Eisenhower State and local funding. Over the course of 18 months the Exploratorium we will work with 68 teachers at the elementary level. and 45 teachers at the middle and high school levels--all from Chapter 1 schools in San Francisco. As part of this intensive focusing, the Exploratorium we will recruit ESL teachers to participate in its workshops, structure a series of field trips for participating teachers' classes, and invite teachers to special events at the facilities. Avenues of communication will be initiated among teachers at all levels by having elementary teachers participate in secondary school activities and secondary school teachers will be included in the elementary enrichment programs. The third major goal is to use the Exploratorium's developing network of community relations as an aid to attracting parents who traditionally resist participating in school-based events.

By increasing the "critical mass" of teachers in Chapter 1 schools, the program will contribute significantly to the quality of science and mathematics teaching in San Francisco, and will help develop a cadre of qualified and motivated teachers who will be better able to take an active hand in developing curricula and working as mentors and role models for their colleagues. Through this work the Exploratorium will demonstrate the efficacy of using a community-based science museum as a direct resource for the enhancement of science teachers.

Senator MIKULSKI. I want to ask Ms. Dufour's comments, if she had any in this area.

But before I do, I get mixed reviews on this diffusion network and, as you can see, I get around. I have my ear out in a lot of different ways, and some say it is OK and some say it is not and that it has a lot of inertia to it, and it looks good on paper, but, like a lot of things that look good on paper, it does not work the way it should, that it just is not effective and lacks real energy.

DISSEMINATION PROCESS

What I am going to ask for is a description of the diffusion network.

Mr. Bloch and Dr. Williams, I would like you and the Department of Education to give me a flow chart from the time your folks designed the Science Education Week material to then what happened to it. What is the critical path all the way into a school district in, say, an urban and rural area.

We do not have to take the large States, like a California or a Texas that are mega-States. But really, a Connecticut and a Utah and so on where we take a look at that. I think it would tell us if we are getting our money's worth for these programs out of the National Science Foundation.

[The information follows:]

NSTW 1990 MATERIALS DISSEMINATION PROCESS

National Science & Technology Week (NSTW) is a unique public outreach and informal education program. Since its inception in 1984, the goal of NSTW has been to provide teachers, parents, corporations and professional organizations with innovative and exciting materials and programs that provide science "early and often" to young people. Working closely with key educational and scientific organizations, and with the financial support of private corporations, the National Science Foundation has coordinated the various programmatic parts of NSTW—most importantly, the development, design and distribution of special educational materials for use in the school and at home.

For NSTW 1990, NSF staff developed a variety of educational and informational materials, including: curriculum packets for elementary and middle school teachers, instructional posters providing science activities and information, public service announcements highlighting science and technology facts and issues, and informational brochures. Planning and initial development of these materials for NSTW 1990 began in the spring and summer of 1989; fundraising efforts with prospective corporate sponsors also occurred at this time. NSF staff coordinated the efforts of many outside groups in the development and design of the various educational materials throughout summer and fall of 1989. By late January 1990, the developmental and design phase was completed and the materials were ready for printing.

In order to efficiently and economically place the NSTW 1990 education materials directly into the hands of the Nation's science teachers, we employed two major dissemination methods. The first is through the direct distribution of curriculum materials at NSTW Teacher Training workshops. Approximately 20,000 education packets were distributed at workshops organized for hundreds of elementary and middle school science teachers in February and March. All teachers were given additional education packets and instructional posters to distribute at their schools. The remaining portion of materials were distributed through NOAA, AAAS, ASTC and other organizations participating in NSTW activities. The second method involves mass distribution through the placement of NSTW curriculum materials and instructional posters in major educational publications. This year's materials received widespread exposure in "Learning" magazine, two National Science Teachers Association journals and "Young American" newspaper with a combined circulation of 1,400,000.

Over the past six years, we have realized that there is a great potential for making a substantial impact in education by developing quality innovative materi-

als and then reaching as many teachers as possible through a variety of dissemination efforts. The dissemination process implemented for NSTW 1990 responded to this opportunity by utilizing the most effective methods based on the amount of funding received for the program.

Senator MIKULSKI. My time is up, but Ms. Dufour, could you maybe give a quick comment on that?

ON-LINE DATA BASE

Ms. DUFOUR. Just very briefly. I think that this is one of the problems that the Committee on Education and Human Resources is just perfectly situated to address. I think that a lot of agencies are already doing things—I know that NASA and DOE co-fund something called FEDX, which is an on-line data base of programs and resources for education.

Senator MIKULSKI. Would you elaborate more on that data base?

Ms. DUFOUR. It is on-line. You dial up. And it is in libraries, it is in school districts, it is in places around the country, and we get a lot of response to that, and I will be happy to provide you with exactly the numbers and where those calls come from.

So the information is getting out there, but it is rather sporadic. The national diffusion network is something that, perhaps, through the Committee on Education and Human Resources, we will be able to make the best possible use of in a coordinated effort.

I would also like to say that this is one of our biggest problems, and that it is compounded by the fact that these teachers often are so isolated in their schools. As Senator Kerrey so eloquently pointed out, these are men and women who are teaching at $22,000 a year. They are often teaching out of their field. They often perhaps are the only science teacher in their schools.

So it is very hard for them, and that is why this is particularly important and something the FCCSET Committee is going to be addressing.

Senator MIKULSKI. Well, thank you very much.

My time has expired and I am going to turn to my colleagues—we are taking it in order of arrival.

Senator Kerrey.

Senator KERREY. Thank you, Madam Chair.

I want to try to get at a bit of philosophy here as to what the administration supports, so you get a heads-up as to the line of questioning I have got. And it is, by the way, still sort of apropos of my opening comment. I am looking for things that work. I think it is very important for us to get things that work.

You referenced the DOE lab in Chicago at Argonne and I am very familiar with the Chicago reform effort, and the mayor is very impressed with that partnership, very enthusiastic about that partnership. The deputy mayor attended the Berkeley conference.

ADMINISTRATION ROLE

But the question that I have is, Does the administration support this kind of Federalized activity? I mean, if you did not have these laboratories, if you did not have these laboratories in place, would the administration be coming forward proposing the establishment

of Federal labs that would be used for teacher training and retraining?

FEDERAL LABORATORIES

Dr. BROMLEY. That particular question, sir, I do not think has been addressed, for the simple reason that we have some 726 Federal labs available to us.

I think one of the more exciting developments in the last year has been the rash of adoptions, where both national laboratories and, following their leadership, private industry have agreed to adopt whole school systems. This is critical, in my view, to giving the teachers in those systems access.

Senator KERREY. But I think it is critical to answer the philosophical question, because if the administration does not support the federalizing of teacher training, which is essentially what we are doing through these laboratories, then it seems to me they should not be doing it.

If you are going to make a virtue out of necessity and use these facilities, which I prefer by the way—I like what you are doing—then I think you have to deal with the geographical inequities that occur when you use preexisting institutions. You must deal with that, because you simply are not going to be able to deliver services to all States and to all of these districts.

If the DOE model is working, if the EPA and the NASA model is working, which I think they are in fact, then what I am suggesting is the administration ought to make a virtue out of necessity. They ought to ask themselves and answer the question, do they philosophically support federalizing educational efforts through this sort of dispersed laboratory system?

If the answer is yes, then I think that you have got to the July conference with the Governors and begin to talk to them about the geographical problems that we have got in the use of these facilities and about trying to coordinate through the States so that you get statewide initiatives in all areas.

Mr. CROSS. If I might, Senator, I would respond in two parts. First of all, in terms of the specific training of teachers, I think that remains more a State and regional responsibility.

Senator KERREY. No, sir; in these laboratories, in these efforts that we are talking about, you are doing direct teacher training and more than training. Teachers are going to these institutions. We have had 26 or 27 people that have gone down to the NASA center in Houston and they come away excited. Now, they have got to pay a round-trip air ticket to get down and back.

POSITIVE SIGNS

Dr. BROMLEY. Senator, I agree totally with you on this. I am making perhaps the finer distinction. In getting the initial formal credentials, that is, I would submit to you, a State responsibility still. But in terms of this enrichment, in terms of making available to the teachers exposure to their field of expertise, the field in which they are teaching, this sort of approach works beautifully.

I think another thing that works beautifully, that has really come into its own since the education summit, is the exchange of

information among the Governors about the establishment of special schools, in a great many of the States, for mathematics and science education. Superb teachers and superb students are beginning to form nuclei that are spreading in the individual States. That I think is critically important.

I think a third thing that I would want to list as important, is that last year, for example, we brought 112 of the Nation's most outstanding mathematics and science teachers here to Washington as the guests of the President for a week. This year we are going to continue that. Both the President and the Vice President will be meeting with them.

But this year we are going to increase the program to bring 112 elementary school teachers in this area as well.

Senator KERREY. Doctor, let us deal with this. We have laboratories in the United States that are run by the Federal Government. Now, a conscious decision has been made to use laboratories that are run by the Environmental Protection Agency, by NASA, and by the Department of Energy, to use these laboratories that are established for other purposes.

It is a separate question, whether or not it drains their resources away from the original mission. Apparently it does not, and I accept that, by the way. I am not here arguing that, but we have established Federal employees in each one of these operations that are doing teacher training.

They are not being flown to Washington, but they are out in the communities doing teacher training, and they are doing a terrific job and teachers come away extremely excited.

The question is, Has the administration dealt with the philosophical question that underlies the use of those Federal resources in this dispersed way? Is the administration prepared to go to the American people and say, we need to federalize this part of our educational effort in that we've got to use these Federal institutions and Federal employees where they are.

If they are not prepared to do that, then it seems to me that you are in a heck of a box, because you have got a tremendous geographical distribution problem here facing States that do not have these laboratories in their States.

Dr. BROMLEY. First of all, the administration is very much in favor of using all of our facilities in this education role. There is no question whatever about that.

Senator KERREY. What is the basis for that?

Dr. BROMLEY. Because we believe that one of the most important questions that we as a nation face is this matter of education at all levels.

Senator KERREY. But sir, I have got lots of other important efforts out there. Are you telling me that if I have got a combat platoon out there somewhere and I happen to have three mathematics people in there, I am supposed to shut down a combat operation while they go out and teach school?

I mean, there are other missions involved here. The question is, what is the rationalization for using these laboratories to do teacher training?

Dr. BROMLEY. In a great many of the cases, sir, the actual training and interaction with the teachers that you just described in fact takes place outside of the normal routines of these laboratories, and it does so specifically because of the enthusiasm of the scientists, engineers, and the teachers on hand.

So I do not believe that what we are saying is that we are substituting this teacher training, as you put it, for other things that the laboratories or the other Federal organizations might be doing.

This is an opportunity and an approval from Washington that this is a good thing to do. That is quite new, because even a few years ago I recall personally in the DOE laboratories having lab managers being told from Washington that they had no business being in education. It is quite different.

Ms. DUFOUR. Senator, I would just like to say that in the DOE and the atomic energy acts there is language that does give us the authority to do this. When you have a Secretary of Energy giving a notice out telling the agency that it is now a major part of its mission to do this, then I think that that sends a message throughout the system that is very important.

The other thing I want to mention is that in our programs for teachers, we do not nominate the participants. Those participants are selected by all of the States and by Puerto Rico and the territories, and those people are selected by the State education offices. We work with the Governors' offices to do that so that there is an even representation.

One of the sad facts is that we do not have as many nominations as we could handle. We do not get the full number from all the States that we request in many States. That is something we would like to see change.

Senator KERREY. But are you suggesting that there is no advantage to have one of these national laboratories right in the community?

Ms. DUFOUR. No; of course not. Obviously, if you are in a community that can be embraced by a major laboratory, that is a considerable benefit.

Senator KERREY. It is much more likely that Fermi will be advantageous to Chicago than it will be to St. Louis.

Ms. DUFOUR. Or to your State, absolutely. That is true.

But there are Federal programs that we feel are undertapped, and we hope through the Committee on Education and Human Resources under FCCSET we will find them.

Senator KERREY. Let me give you an example here of another successful effort, I think. In fact, I could give you examples of private ones, but I will give you, for the sake of not wanting to get into the church-state argument here this morning, a public example.

The North Carolina School of Mathematics and Science is a tremendous success story. I do not know of anyone who has gone there that has come away without being impressed with it. Does the use of the Federal laboratories, does the use of Federal employees doing teacher training in an educational effort out there, justify the Federal Government, in your opinion, supporting efforts like

this school and encouraging efforts like the School of North Carolina Math and Science?

Could you envision, based upon this philosophical decision to use these laboratories, the administration suggesting that we have Federal efforts out there like the North Carolina School of Math and Science?

Ms. DUFOUR. I am not in a position to answer that. But one thing I can say is that the use of these laboratories has gone a long way to stimulate industry throughout the country to do this, though in many places you will have the same industry inequitably distributed throughout the country. This is a problem that we are working on.

But it is not just the Federal effort. That is used as stimulus. There are, for instance, the Department of Agriculture has offices in every county in the country. There are things that we could be doing that we are probably not doing as well as we could.

Senator KERREY. What does the Department of Education think about that? How would you respond to the question about a comparable circumstance existing perhaps between the North Carolina School of Math and Science and the use of a Federal Education, EPA, or NASA facility for an educational effort?

Mr. CROSS. Well, Senator, I would mention that the Eisenhower Math and Science Program, which as you know is primarily a formula grant program to the States, can, in fact, be used to support training of teachers for schools such as the North Carolina School of Math and Science.

That is a State decision, however.

Senator KERREY. I am talking about—again, either I am not saying it correctly or the answers are not coming right. I am talking about Federal employees. Now, these are people that get their checks cut and mailed from Washington, DC. They are Federal employees from the United States of America. We are talking about the United States competing against other nations, so the United States is making an effort, and I happen to think correctly, through these Federal facilities to assist in education.

PHILOSOPHICAL QUESTION

And I am asking you, Have you asked and answered the philosophical question that underlies that? Has the administration made a conscious decision that said that it is OK for us to federalize this portion of the educational effort, and if that answer is yes, that the administration has asked and answered that question yes, then what does it think of supporting, either with direct grants or with a direct effort, efforts like the North Carolina School of Math and Science?

Dr. BROMLEY. In my case, let me simply say that, with the North Carolina school, I have had the pleasure of visiting it. The major support there comes not from Federal employees, but rather from the employees of private sector companies in the research triangle. They have been extraordinarily generous with their people and with their funds.

I think what we have done across the Nation, though—to respond to the problem that you quite correctly raise about geograph-

ic distribution—is to focus on bringing the teachers to the laboratories where the Federal employees are, rather than trying to establish new centers on a more geographically, uniformly distributed basis to do this training.

That may come. It may well come. But as yet the focus has been on providing the kind of funds for summer programs or for other, more lengthy stays for teachers at the national labs, wherever they may be in the country.

Senator MIKULSKI. Senator Kerrey, you raise some very important questions, and I think we should continue to pursue them in future hearings we are going to have on these topics.

DISTRIBUTION OF LABORATORIES

I know of your concern about the distribution of laboratories, and yet each of the agencies has laboratories within nonmetropolitan areas. You heard about the DOE. We could go to the philosophical issue and so on, but I just want to give you an example about NASA, which we will be talking to shortly.

They are in Huntsville, they are in Texas. They are in places, by the way, where there is a substantial African-American population. When one looks at the profile of scientists and engineers, African-Americans are severely underrepresented.

One of the things NASA is doing, like at Brevard, is to link up with the community college and offer a space technology major for a lot of those kids who cannot go on. Brevard and NASA are working together with the private contractors on this.

I brought them into Maryland, because Prince Georges County, where they are located, needs their stimulation. They have been a catalytic force to eliminate the inertia that is in the field of education, particularly at State levels. The State bureaucracies tend to be the most inert, and when the Federal agencies come in they do not substitute for what State and local governments do, but it jump-starts the thinking and then Governors get the idea. Then the boards of education follow up at State and local levels, and then improvements begin.

Then you know what happens? For the nearby States, it has a multiplier effect. I know it is not a national program, but it has been a jump-start program in some geographic areas, especially in some important emerging populations of cultural diversity, such as Texas and California and so on.

So we want to get back on track here, but I thought you might find that dimension to be interesting. But the Federal Government is not a substitute. The Federal Government is not a Department of Education by proxy at the State level, but it is a jump-start. And you know what? The communities get the contributed services of the private contractors on Federal funds. The private contractors often become partners in education, particularly on space and the environment, and a lot of it is voluntarism out in the community, or hiring teachers for the summer to work for, say, Ford Aerospace. Everyone wins.

Senator KERREY. Madam Chair, I just point out that beauty is often in the eyes of the beholder, and as a former Governor I re-

member many times thinking there is nothing more inert than the Federal bureaucracy.

Senator MIKULSKI. As a city councilwoman, I thought both were a little sluggish. [Laughter.]

Senator KERREY. Thank you.

Senator MIKULSKI. Senator Grassley, we have been waiting all morning for your opening statement. I know you do not have one, but if you have a line or two, and then also your questions.

Senator GRASSLEY. Well, you will not hear much from me now, because I have got to be on National Public Radio at 11:10 live.

So I am going to go through a series of questions with you, Dr. Bromley, and I am going to have to ask you to submit your answers in writing. But I did not want to just submit them in writing, so I want you to know where I am coming from.

My colleagues are legitimately concerned about what comes out of the Federal Government as a product in improving education in math and science, and that is legitimate and I share that concern as well. But in my questioning I want to focus upon the FCCSET Committee and the whole umbrella that it involves, as I anticipate it, seeing that we get maximum efficiency through cooperation of all the different agencies that are involved.

I do not know whether this is a fair description as I see your job, but I hope it is, because it is the basis of my questioning.

The President of the United States wants to make sure that we have maximum cooperation from the various agencies of government that are involved in science education to improve our technology. So this is his goal. He puts you in charge of a committee to see that this job gets done. Is that right?

Dr. BROMLEY. That is correct.

Senator GRASSLEY. And so you are kind of a czar in this area, whether you want to be seen as a czar or not? But I assume you have responsibility, through the President, to get this job done, and if you do not have the power out of your position to get it done, the President of the United States has the power to get it done. Is that right?

Dr. BROMLEY. That is correct.

Senator GRASSLEY. Is that a fair description?

Dr. BROMLEY. The historical record on czars has been rather bad.

Senator GRASSLEY. Yes; well, that is why I am just saying it. That is kind of in quotations.

Dr. BROMLEY. Good.

Senator GRASSLEY. So my questioning then is along, is this administrative structure going to accomplish what it is intended to accomplish?

Dr. BROMLEY. I believe it will, sir.

Senator GRASSLEY. So I would like to have you in writing tell me, as you have seen the job so far that you have had it, the preliminary work that you and the working group of the FCCSET Committee have already begun, where do you anticipate shortfalls on the one hand and overlapping efforts on the other in the work that is done through Federal agencies pertaining to science and math education?

BUREAUCRATIC LETHARGY

Next, what mechanisms will the FCCSET Committee utilize to ensure that the policy recommendations resulting from your work will be enacted by the agencies involved? And if perchance you would say, well, you know, that comes through the power of the purse—and I am not sure that that would be your answer, but if it would—I want to specifically—I think that I need to anticipate from you how these agencies that you supervise are going to respond to that sort of effort, because you know, even though we have one President in this country, one Chief Executive, there is still a lot of lethargy in the bureaucracy.

I do not care how good you are, it is just difficult to get the job done. The President has got good intentions on defense reform and he is Commander in Chief, but I will tell you he just gets undercut by the services and by the professional military and the bureaucracy all the time, and I do not know whether he knows it.

But that maybe is just worse in the Defense Department, but it has got to obviously be quite a challenge for you as a czar in this area to get this job done.

So if you anticipate doing that through the budget process, I want to know if you really think you can get that done and how they respond to it.

Then you would expect a fiscal conservative like me to be interested in whether or not you anticipate any cost savings in this, and those could be cost savings that put money in the pot, or it could be cost savings that get us more education. I would accept either one, but I want to know if that is the case.

And in regard to cost savings or efficiency, I would like to have you, if you anticipate some—if you do not, then of course this followup question would not be applicable—but when you discern savings potentials from the FCCSET Committee's efforts. And in that regard, I would like to have you be very specific with the time, maybe not time of day, but at least time of the calendar.

So do you think you could respond to that?

Dr. BROMLEY. I will certainly be pleased to try to respond to those questions, Senator.

Senator GRASSLEY. I do not want them to detract from the points that my two colleagues were making about what is coming out at the end of the pipeline.

Dr. BROMLEY. My only reservation, Senator, is that we are at an early enough stage in the activities of the FCCSET Committee that it will be difficult for me to give you as full an answer as I should be able to later. But I will certainly be able to give you a status report of where we are and where we are going.

Senator GRASSLEY. I thank you.

Madam Chair, I thank you.

Senator MIKULSKI. Thank you, Senator Grassley. Those were very spirited remarks.

Again, I think one of the important things, Senator, not only is your attendance faithful, but you know, also with Senator Kerrey, so much of education is often focused with urban or concentrated population areas, or much of the work we do, and we really thank you for the insights of rural America.

Senator GRASSLEY. Thank you.

Senator MIKULSKI. What we are going to do now, I know that the next panel is waiting and the people involved have many pressing duties.

But we are going to go for another round of 5 minutes each between us and then go into the second panel. So I am going to ask one more question and then, Senator Kerrey, if you care to. I have many more.

ALTERNATIVE CERTIFICATION

I would like to come to again this issue of having more teachers in the classroom. My questions will go to the issue of alternative certification. I was mesmerized when the President proposed that idea and looked into it, and I found, to my surprise as I looked into certification issues, that neither Sally Ride nor I could teach in the Baltimore school system beginning next fall.

Dr. Ride would not be considered qualified to teach physics and math at Western High School, an all-girls high school in Baltimore. I would not be considered qualified to teach history, civics, or current events. Now, something is wrong when a Dr. Ride and a Senator Mikulski, who both of us have taught at college levels, cannot walk into the classroom.

I want to be very clear. I do believe in certification. I do believe that when you walk into the classroom you should be ready and able for duty. But I do not believe that you need a master's degree, particularly in secondary education.

As we have an aging population, people looking for career opportunities, early retirement from Federal employees in these laboratory resource-rich areas, so my question to the panel is, When the President proposed alternative certification what did the President mean? And No. 2, What are we doing about implementing the idea of alternative certification, recognizing that we do believe that you need to be trained to be in a classroom?

I am going to focus that particularly in the science and math area.

Mr. BLOCH. Go ahead.

Dr. BROMLEY. Well, first of all, Madam Chair, I think that one of the most dramatic examples of the success of that has been in New Jersey, where it was recognized that there was a large population of retired scientists, engineers, and mathematicians who were interested in teaching, but who were not prepared to take 2 years to get the necessary certification.

The Governor took the initiative to simply arrange that, if you had qualifications in the field in which you wished to teach, then, in fact, you could be certified by the Governor. That is spreading. It was something that came as a great surprise to the participants in the education summit, and I think that it is going to spread through the entire Nation over the next few years.

I agree that it is probably one of the most effective ways that we can respond to the tremendous shortage we have of adequately qualified teachers in these areas.

Senator MIKULSKI. Mr. Bloch?

ADJUNCT TEACHERS

Mr. BLOCH. I think one should take a lesson from other areas in that regard and have a concept of adjunct teachers, where we can bring people who are retired——

Senator MIKULSKI. Like adjunct professors.

Mr. BLOCH. Just like adjunct professors in a university—and take advantage of people who have a good background in a particular topic, like mathematics or one of the sciences, who have the time and are willing to give it to this particular effort.

I think that should be spread throughout the country. I think it is probably up to each individual State right now to authorize that. It is not a Federal kind of an authorization. But one should take a look at that possibility.

Senator MIKULSKI. Your State Initiative Program, as I recall when you briefed us on it at the appropriations hearing, had that as one of the elements for reform at State levels?

Mr. BLOCH. Well, as you recall, we did not want to be very specific and lay out what is allowable and what is not allowable. We wanted the States to come forward, and we encouraged them to reach out to all parts of their communities and to society, to bring forward an imaginative new kind of endeavor.

It would surprise me greatly if some of the States would not capture that kind of an idea.

Mr. CROSS. Madam Chair, if I might add that the authorization for an alternative certification program has passed the Senate already and I think early this week has passed the House Education and Labor Committee and should go to the floor later this summer or fall.

So we should have an authorization on the books by the end of this Congress, and, hopefully, an appropriation.

Senator MIKULSKI. Well, how do you all feel about alternative certification?

Mr. CROSS. I am very supportive of it. I agree with your comments wholeheartedly.

OPPORTUNITIES OFFERED BY DEFENSE WIND-DOWN

I would also add that the situation in the defense economy, with the military looking at decommissioning a number of people and with the defense industry looking at some wind-downs, this is an opportunity for the teaching profession, an opportunity for education to get some of these well-trained people into the classroom.

I think it is a tremendous opportunity.

Senator MIKULSKI. Well, it is a problem. I mean, the educational establishment is real wary of this. When I spoke to Al Shanker, he was for it. When I spoke to the Maryland State Teachers Association, they were less than enthusiastic and I think they were nervous, because sometimes in the rhetoric of alternative certification there is implied that no certification is required.

I will tell you, I am incapable of teaching reading at a secondary or primary level. I would need a tremendous amount of training to do that, and I would need a lot of help to go face those junior high school kids. I think I would need biofeedback [laughter] as well as some important techniques.

But I think we have to recognize that. But at the secondary level, and that is what we are talking about, using our people more appropriately.

Ms. Dufour, did you want to comment on that, and then my time has expired.

Ms. DUFOUR. Yes, Senator. We have a pilot program in Tennessee, and again it is because it was started, initiated by the Governor in that State following the education summit. We are working with the University of Tennessee and Oak Ridge National Laboratory to develop an alternative certification program.

One of the interesting things was that the people that we expected to apply for the program we thought would be our senior, ready-to-retire folks and, in fact, it was a younger cadre of scientists who were interested in making a mid-career change. So we are very encouraged by that.

Senator MIKULSKI. Well, thank you.

Senator Kerrey, did you have any, another question?

Senator KERREY. Yes; I do, Madam Chair. Thank you.

I would just point out that I assume that the feds do not intend to override State law on alternative certification.

Mr. CROSS. It is up to the States to apply for the program, and it is within the States' power to determine what that program would be.

Senator KERREY. I would just say, for whatever it is worth, to those of you who are interested in it and are advocates for it, I fought to try to get it done and lost when I was Governor.

I must say, though, I am still a strong advocate of it. I very often hear it oversold as a magic solution for all problems that we have got in public education. But, I support it and I fought for it and I have had my State education association oppose me in that effort. I think it is movement at the margin, although I think it is important reform.

STATES INITIATIVES

I would like to deal with the States initiative that NSF is working on. One of the things that we are trying to do at home is to, again apropos of what I said at the beginning, identify those things that work and try to support them. In addition to the things that Dr. Williams talked about with me yesterday, where we are focusing on teacher training, curricula, school organization. Not being a professional, it seems to me my role includes trying to disseminate, help in the dissemination of information, or trying to put people together.

What we are trying to do is focus on six or seven things that we see that work. I mentioned already the North Carolina School of Math and Science that we are interested in for our State. We have also started an early childhood program based upon the Comer model at Yale with 3- and 4-year-old students, and we are going to try to get some resources to some private schools that are also doing an exceptional job in math and science.

ADULT EDUCATION IN MATH AND SCIENCE

Technical training at the postgraduate level is extremely important for us. We find ourselves, in fact we are wondering whether or not we should not be starting much earlier in the schools for those who are not going to go on to college.

The problems of teaching freshmen in college math and science has been identified by people in our State as being a tremendous problem—many people get turned off as a consequence of being taught by people in large classes that are not very enthusiastic themselves about math and science.

The problem of adult education in math and science is important. The problem of using and trying to identify how we could use the technology, which I suspect is why the DOE and NASA facilities are so exciting for our people, because you have got a direct technology application there

My concern, frankly, is that although NSF has an exciting new program, we could have as few as four or five grants available for States, and that it is uncertain as to whether or not those statewide initiatives are going to be followed up on. I guess it is sort of an open-ended question as to whether or not the administration has thought about expanding this statewide initiative so that all the States can be engaged in it.

We are having a conference in Nebraska in July. We are using the private resources that you mentioned. We are using the professionals that are in the schools, both the private and the public schools. We are trying to engage as many people as possible.

But that statewide initiative that NSF is proposing is very, very attractive to us, and we are very much aware that, even though I sit on the Appropriations Committee, we may not be selected. And frankly, I am not interested in just seeing Nebraska selected. If it works for Nebraska, I would like for other States to have that opportunity.

Mr. BLOCH. Let me answer, Senator Kerrey, on that point. I would hope—first of all, let me say categorically, if that first round is successful—by "successful" I mean if you really get the kind of program that we all envision and that we all would like to see—no doubt about it that we are going to continue that program a second or third or fourth time and so forth. So that is point No. 1. It is not just a one-shot deal and we are done with it.

NEED FOR COMPETITION

The second point, however, that I wanted to mention is the following. I think it is very important to have some competition in that. We should see what kind of ideas we are getting. We should see what the States themselves consider to be the important aspects, how they can muster their own resources and how they can tap into other Federal programs.

Therefore, the worst thing we can do is to say everybody wins, everybody gets an award. I think there should be competition and we should learn from the competition, and the second and the third time around some of the States that were not successful will change their ideas and their approaches and could very well be successful. We have done the same in other programs.

Senator KERREY. Let me just ask you quickly, did we have competition for the DOE labs? No; we did not.

Mr. BLOCH. I cannot answer that, but I can tell you that we had and have a lot of competition for the science and technology centers, for the engineering research centers, for the earthquake center, and on and on.

Senator KERREY. Mr. Bloch, I do not want to lock into one of the classic arguments that you and I have had in the past, but I believe that you are wrong. I quite agree with the generalized assumption that competition is good, but I do respectfully think you have got a terrific idea with the State initiative, and I think it is such a good idea that I think in this instance we should not have the States competing. Hold them to standards. Make them produce. But, give them a chance.

I very respectfully suggest that this is an idea that the administration should consider taking directly to the States and have them go ahead and do something rather than having them compete to determine who is going to win and who is going to lose.

I understand that you and I disagree on the issue.

Mr. BLOCH. I respectfully disagree.

Senator MIKULSKI. Well, this is pretty good, and I am going to thank the panel for their participation and their candor, and we look forward to the FCCSET report. When is that due?

Dr. BROMLEY. It will accompany the 1992 budget submission, Madam Chair.

Senator MIKULSKI. Great; and we look forward to additional work and conversation.

This panel is excused, and now we call Admiral Truly, Mr. Habicht, and Anthony Principi of VA.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

STATEMENT OF ADM. RICHARD F. TRULY, ADMINISTRATOR

ACCOMPANIED BY DR. ROBERT BROWN, HEAD, NASA EDUCATION PROGRAM

INTRODUCTORY REMARKS OF SENATOR MIKULSKI

Senator MIKULSKI. We apologize to the second panel for being so late, but I think you could see once we got into it we were going to stay. We feel that, now that we have heard from those most involved in education, we would like to talk with the people in our subcommittee who have a very important stake, if you will, in work force readiness, and for whom we need to increase our pipeline flow of science graduates from the laboratory technician, nurses, paramedics, M.D.'s at VA, to our environmental and space scientists.

So we look forward to this testimony. We know that we have talked with you on other occasions about what you are doing, and we have funded various scholarship programs proposed by the agencies. As Admiral Watkins has said, Federal agencies everywhere have a stake: 147 hospitals that could get community colleges to focus on their pipeline needs; NASA in their States where there is a tremendous population of people of color; if in EPA's 10 regions we could pique the interest of 10 future scientists out of every Superfund site, we would be doing all right.

So we again welcome you, and I know some of you have designated educational coordinators.

Admiral Truly, you do.

I would like you to introduce Dr. Brown.

So why do we not start off. Admiral, I know today you would like to at least tell the country some good news. So let us hear from you first. Then we will go to EPA and wrap up with VA.

Admiral TRULY. Thank you very much, Madam Chair. Let me first thank you, as did the other members of the first panel, for holding this hearing. I can assure you this is a subject very close to NASA's heart and to my mine.

I am very lucky to be joined here this morning by a very talented person who heads our education program, Dr. Bob Brown. I would like to introduce him.

Senator MIKULSKI. Dr. Brown, please come up and join the panel.

Admiral TRULY. If I might submit my statement for the record and summarize it, I would like to do that.

Senator MIKULSKI. Please do, without objection.

Admiral TRULY. First I would like to say that in the first panel you heard from Dr. Bromley and Mr. Bloch. Admiral Watkins, and Under Secretary Sanders were not here. But let me say that I personally have met with each of those individuals on this very sub-

ject and in the FCCSET Committee and in the Domestic Policy Council.

I believe that Dr. Bromley's leadership in the FCCSET is a major contribution to coordination between the agencies, and we probably have worked most closely with the Department of Education, with Admiral Watkins, on a number of initiatives. And so I thoroughly enjoyed that part of the hearing.

SUMMARY OF STATEMENT

I think the history is clear. Never has this subject been more important to our country. I think the statistics are clear. We have an extremely serious problem and it remains and it is a dogging problem with us.

We have goals that have been set, not just by the President, not just by the Governors, but by them together for the Nation. What we have done so far is simply not enough.

NASA MISSION

I would like to tell you a little bit about some policy changes and influences that I have made within NASA and I would like to focus principally on what we are doing, what the programs are and where we are going.

We view our mission in education as ranging all the way from preschool through graduate school. I agree with Dr. Bromley that we should spend our time concentrating, particularly in the math and sciences, on a younger and younger age group. You will hear in a moment as to how we are trying to do that.

I believe that it is our responsibility to assist the States and school districts in inspiring students. And I think one point that you made earlier, and the most difficult problem that NASA sees, is leveraging the programs that we have so that we can get into every one of the 16,000 school districts.

We cannot do that on a personal one-on-one basis, but through publications, through satellite television, and through new technology, I believe that our programs can get to kids. But to do that we have to become more and more efficient in leveraging those programs that we do have.

We deliver our education programs through a variety of means. We have spacemobiles, we have teacher resource centers, we have satellite television that puts on scheduled TV programs to teachers and students. We fund fellowships, fund internships, and sponsor conferences.

STRATEGY AT NASA

Our strategy is very simple, even though across NASA we have over 160 individual small programs. Our strategy consists of three thrusts. The first goal is to capture the imagination at the earliest possible age of young people and to make them understand that the study of math and science does not have to scare them away from an exciting career. I am not talking about just creating mathematicians and scientists, but to take a general population of young people and make them literate so that they can, in this

modern world, understand and appreciate the excitement of math and science.

So the first thrust is to capture their interest early, and I will try to tell you how we do that.

The second of our thrusts is to try to channel students whose imagination has been captured to careers in math and science, because that is what NASA needs. We need bright people, engineers, scientists, technicians to do our job. We cannot do our job without those people, and when you look at the number of people with degrees that we are putting out in the future we are in trouble.

Finally, the third thrust is to enhance the skills of the teachers, to put tools in their hands so that they can challenge the young people early and then channel them into the right roles.

We are looking presently at the national goals and we see connections between NASA programs and all of them, but principally in the four national goals of increasing high school graduation rate, enhancing student achievement and citizenship, particularly the goal in math and science, and finally, adult literacy and lifetime learning.

TYPES OF PROGRAMS

What I would like to do now is to just give you some quick examples of these three different thrusts, as to the types of programs that we have. First of all, capturing young people at a very early age, our space exposed experiment developed for students [SEEDS] project. We flew millions of seeds, in conjunction with a private company, on the LDEF spacecraft.

Senator MIKULSKI. Are those not tomato seeds?

Admiral TRULY. These were the killer seeds that got in the newspaper. [Laughter.]

But let me tell you that that program has touched children across this country. We have had requests from every State in the Union, over 100,000 teachers and students in classrooms. We have sent them teacher's guides, and across this country today young people are talking about biology, they are talking about, learning about, what chromosomes are. They are talking about plant life.

The reason they are excited, frankly, is because one of the seed packets we provided them flew in space, and the other seed packets are from Earth, and they can begin to understand what science is all about.

We had a program that is now completed about naming the new orbiter to replace the *Challenger*. We did not name that within NASA. We had a nationwide effort to get young people to present names to us to be selected. And the price of the ticket to participate was for young people to do a project on space flight. It interests them. By doing the project, they learn and get captured.

We teach from space through astronauts. Our heroes and heroines of the astronaut corps are very exciting to young people, and we will literally be teaching classes on the next science mission directly into schoolrooms from space.

In the second thrust of channeling students, we particularly focus on minorities, handicapped and women. We are developing the National Scholars Program, which is a series of high school

and graduate school programs that has a goal of increasing the number of Ph.D.'s in math and sciences by a total of 320 per year in the next 10 or 12 years, which NASA and the Department of Energy are doing together.

Again, in channeling young people into these careers, we have a joint effort between NASA and the American Association for Counseling and Development to counsel young people and tell them about careers that they did not know about when they are in those middle school and high school ages.

We have efforts that I know you are interested in with the community colleges. We have a particularly successful one at the Kennedy Space Center to recognize the important role of technicians to our work, some more at some centers, some at others.

We have a new program that we initiated, thanks to the Congress supporting us, the Space Grant College and Fellowship Program, involving 21 States which includes a larger number of colleges and universities. We currently have a call out to expand that program.

Most recently, we just initiated a Global Change Fellowship Program, where we selected 37 students that will get graduate degrees. It starts in the 1990–91 school year, renewable for 3 years.

Finally, the third thrust is enhancing the skills of teachers, which is most important. We have pilot projects with colleges of education on the theme of aeronautics and science. We have the LASER vehicle that goes around this country, in a partnership, funded by private industry, but designed by NASA, to take teacher resource centers on wheels, with the prior coordination with school districts, into Chicago, Utah, Nebraska, all across the country.

Senator MIKULSKI. Admiral, I am going to turn to the other witnesses. Those examples are what I love to hear and we will come back to it. But I know we need to move with a little bit of a quicker step, and we thank you for your testimony.

Admiral TRULY. Thank you, Madam Chair.

[The statement follows:]

STATEMENT OF RICHARD H. TRULY

Madam Chair and distinguished members of the Subcommittee:

I am pleased to have the opportunity to testify before you on the importance of mathematics and science education in America. NASA supports a strong education program which seeks to kindle students' instinctive interests in airplanes, spacecraft, astronauts, and space exploration to draw them into the disciplines of mathematics, science and technology.

I am especially pleased by the presence and testimony during the first Panel of two close colleagues -- Dr. Allan Bromley, the Assistant to the President for Science and Technology; and Dr. Erich Bloch, Director of the National Science Foundation. Although personal circumstances prevented Admiral Watkins, Secretary of Energy; and Dr. Ted Sanders, Under Secretary, U.S. Department of Education, from appearing today, they have sent very able people to represent them.

Each of our agencies has a vested interest in and national responsibility for improving mathematics, science, and technology education. Individually, our agencies' education programs reflect our special missions, specialized workforces and unique facilities. Collectively, we are using several promising mechanisms to work together. An extremely important collaborative mechanism entails NASA membership on the Education and Human Resources Committee under the Federal Coordinating Council for Science, Engineering and Technology (FCCSET), sponsored by the Office of Science and Technology Policy. Another includes a recently negotiated Memorandum of Understanding on Science and Mathematics Education between NASA and the Department of Energy. We also consult with the National Science Foundation and the Department of Education on a number of science and math education areas.

At no time in our history has education been so prominent on the national agenda. The statistics that mark the education problem in this country have been talked and written about over and over. But quoting statistics won't make the problem go away. Statistics won't open our children's eyes to the excitement of math, science, and technology. We will need to take action to stimulate and implement educational reform.

Our country urgently needs a continuing supply of young scientists, engineers, and technicians to keep our nation economically and technologically competitive. The compelling national education goals set by the President and the Governors require that we develop more innovative educational outreach strategies, while retaining our proven educational programs. We cannot simply continue to do what we have always done, because that has proven not to be good enough.

I am tempted to tell you about NASA's exciting portfolio of education programs coordinated through the Educational Affairs Division of our External Relations Office and in concert with our nine field centers. This comprehensive array of educational programs parallels the diverse nature of our aeronautics, space science, and exploration programs. Our education budget is not large, but the unique aerospace content

of our education programs provides great popular appeal. This and the participation in our programs by the professional education community makes our programs stand tall among all of the Federal agencies that conduct science and education outreach programs.

I would like to focus my remarks today on the educational policy changes that I have initiated to strengthen NASA's education program and on the new education outreach programs that have been started during my Administration.

Refocussed Education Policies

I have made several policy changes to improve the design and execution of our NASA Educational Affairs Program. The first change has been to clarify the mission of our external education program. The new mission statement directs NASA to conduct and promote aerospace education programs and activities, from elementary school through graduate school, in order to assist and inspire more of today's students to prepare themselves for careers in science, engineering, and technology.

NASA's educational strategy, in order to achieve this goal, is comprised of three elements designed: 1) to capture student interest in science, mathematics, and technology at an early age; 2) to channel more students into science, engineering and technology career paths; and 3) to enhance the knowledge, skills, and experiences of precollege teachers, college and university faculty, and other educators.

NASA's educational strategy is closely aligned with the six national educational goals the President and the Governors have established for the nation. While we will address all of the President's goals, NASA is structured to make the greatest contribution to four. Those four goals concern increasing the high school graduation rate; enhancing student achievement and citizenship; making U.S. students first in science and mathematics achievement; and advancing adult literacy and lifelong learning .

To ensure a close coupling of NASA's activities with the President's goals, I have designated the Director of our Educational Affairs Division to be a member of the White House Education Summit Follow-up Committee.

In pursuing our educational programs, NASA leverages its aeronautics, space science and applications research programs to yield a wide range of activities, experiences and materials for use in the educational community. We deliver these educational resources to the community through a variety of ways. We have a small unique team of aerospace education specialists who conduct classroom and assembly lectures and give demonstrations. We develop supplementary curriculum materials and administer national student competitions. We provide fellowships and internships. We conduct and participate in educational conferences and conventions. We offer urban community education enrichment programs. We maintain computer data bases on aerospace education. And we conduct satellite video broadcasts to teachers around the country.

I have established NASA's educational programs as a separate line item, beginning in the FY 1990 NASA budget. Listed under the title of Academic Programs, this additional measure elevates and identifies education as one of NASA priorities. Our FY 1991 budget request for education is $50.1 million, representing an increase of 35 percent over the current $37.0 million program level.

Recently we began a process to update and convert NASA's existing Five-Year Educational Affairs Plan into a ten-year plan. In this way, the plan will correspond to the time frame of President's national education goals for the 1990-2000 decade. In addition to maintaining the three elements of NASA's fundamental educational strategy, this more comprehensive plan, entitled Science and Technology Literacy for the 21st Century (STL-21) will also include the following guidelines:

* We will emphasize educational programs and projects that leverage our resources by having a multiplier effect on the target groups we seek to reach.

* We will substantially increase the number of underrepresented minorities, women, and handicapped participants in all of our educational programs.

* We will target all students, rather than just the traditional 5 percent who are highly motivated toward science and technical careers.

* We will use and promote increased application of educational technologies to deliver aerospace education programs. Among such programs are live and recorded lessons from the astronauts on appropriate Space Shuttle missions; satellite video broadcasts; expanded use of NASA Select for educational broadcasts; computer access information systems; laser disc technology; and educational software development.

* We will form additional partnerships with other Federal agencies, private industry, foundations and other organizations to coordinate educational resources.

New Outreach Initiatives

NASA's educational programs have one principal goal -- to increase the number of scientists, engineers and technicians available to contribute primarily to the civilian aerospace workforce, and secondarily, to other workforce segments of our economy. But to meet this goal, we need to have a comprehensive educational outreach program, from the elementary level through university level. The three elements of NASA's educational strategy have guided the development and evaluation of all NASA education programs. First, we know that students become interested in science, math and technology at an early age. Conversely, they can be "turned off" at an early age. Therefore, it is important to me that NASA has a broad outreach program to capture a student's interest in science, mathematics and technology at the elementary and middle school levels by using aeronautics and space as a vehicle of excitement. Second, once we have captured that interest, it is important to have a broad and diverse set of informal educational

experiences that channel secondary and university students into science and engineering career paths. Third, it is not enough to have a comprehensive program only for students. We must leverage our resources and help our teachers and university faculty enhance and update their knowledge, skills and experiences, thus providing a significant multiplier effect on their students.

Early in my tenure, I asked my staff to analyze our existing educational programs in light of the three elements of NASA's educational strategy just discussed -- capture, channel, and enhance. I challenged them to look for new ways to use NASA's exciting missions, unique talents of our staff and our unique facilities to determine how we could do more to help alleviate this national crisis in education. I would like to share with you some specific steps we are taking in this regard. And I would like to emphasize that I am providing only highlights of our programs in these three areas. In total, NASA is conducting over 150 separate educational programs; I am describing only a few.

Capture Student Interest in Science, Math and Technology at an Early Age

The Space Exposed Experiment Developed for Students project (SEEDS) is an example of one of our unique educational activities designed to stimulate student interest in science, mathematics and technology. This cooperative project between NASA and the Park Seed Company involved distributing to teachers some 12 million Rutgers tomato seeds that were returned to Earth after having been in orbit on NASA's Long Duration Exposure Facility (LDEF) for over five years. The space seeds, along with a set of control seeds and a Teachers' Guide, has enabled students to compare the seeds for germination time and rates, seedling vigor, phototropic responses and fruit products. More advanced students are performing chromosome and population genetics studies. Through this project, students are learning how to design their own experiments, test hypotheses, collect and classify data, make decisions, and report results. Since April of 1990, we have distributed over 100,000 space tomato seeds kits to elementary and high school teachers in every state.

By bringing together the talents of astronomy mission managers, the Space Shuttle astronaut crew of STS-35, and our educational staff, we are piloting a new approach of teaching live lessons from space. Our pilot effort will be applying the science of the Astro-I observatory to a topic taught at the middle school level -- the electromagnetic spectrum. This pilot effort involves teaching a lesson on the spectrum to students assembled at the Goddard Space Flight Center and the Marshall Space Flight Center. The educational lesson taught from the Columbia will be edited into an educational video tape that will be supported by a teacher's guide, slide set and poster so that the educational value can be shared in classrooms throughout the nation for years to come. More importantly, this pilot program forms the basis of a new working group I

have established to systematically develop educational plans related to specific NASA missions for the 1990's.

My view is that we must concentrate more and more on younger and younger people. It is not too early in kindergarten and even before to have programs to teach parents to do simple things to make their children receptive to the excitement of math, science, and technology. We talk a lot about the brilliance of some of our university students and the achievements of some of our high performers. At the same time, we cannot afford to lose the attention of the majority of our American youngsters where math and science are concerned.

Channel More Students into Science and Engineering Career Paths

Improved education for minorities, women and the handicapped will increase the availability of scientists and engineers for future programs and thus will prove to be one of the real solutions to the nation's educational competitiveness problem. The demographics of the work force is changing and if we cannot excite more young Black, Hispanic and female children about math and science, then we are not going to have adequate manpower to be competitive in the international arena. In this respect, NASA has initiated an innovative government/private sector program called the National Scholars Program (NSP) which I cited in my November 1989 report to the Congressionally mandated Task Force on Women, Minorities, and the Handicapped in Science and Technology.

The goal of NSP is to have all relevant Federal agencies and various private sector organizations fund a series of programs at the high school level through the graduate school level that would result in the production of more underrepresented minority science and engineering Ph.D's. NASA and the U.S. Department of Energy, through our Memorandum of Agreement, are getting the program started by folding into NSP many of our existing programs.

We are adding a new component to our highly successful Space Science Student Involvement Program (SSIP). Each year, over 1,000 junior high and high school students participate in a national competition by submitting proposed experiments that theoretically can be tested, for example, on a Space Station, in the wind tunnel at the NASA Langley Research Facility or the microgravity research facility at the NASA Lewis Research Center. The new component of the competition will involve research proposals for supercomputers and result in awarding Super Computer Internships at our Ames Research Center.

Another effort to influence the career paths of more students is our collaboration with the American Association for Counseling and Development (AACD). School guidance counselors give students critical assistance in understanding the variety of careers available and in choosing the necessary courses to those career paths. Recently we convened an exploratory meeting with the AACD to look for ways to work together, including the development of new student materials concerning technical careers.

As we anticipate the increasing demands on our future science and engineering workforce, we have become even more sensitive to the important role of technicians, many of whom receive

their education through community colleges. We have also come to appreciate that community colleges enroll a significant proportion of the nation's 12 million students in higher education, and that these institutions enroll approximately 40% of all minority students in higher education. Consequently, we have begun to examine ways in which our education programs, both external and internal, can work more closely with community colleges. We already have good experience with one model for this approach -- Kennedy Space Center's working relationship with Brevard Community College in Cocoa Beach, Florida.

Last year we carried out Phase I of the National Space Grant College and Fellowship Program. A major emphasis of this program is to provide both undergraduate and graduate fellowships to the 21 designated Space Grant Universities/Consortia with emphasis on recruiting women and underrepresented minorities. This new effort significantly increases NASA's existing fellowship programs to channel more students into the science and engineering pipeline.

Enhance the Knowledge Skills and Experience of Teachers and University Faculty

Reaching out to enhance, encourage and strengthen teacher skills is the third part of our strategy. It is a key element because it is where NASA has the best opportunity to leverage its resources and to ensure sustained change.

Recently we announced a new effort to infuse the theme of aeronautics and space into the training of teachers enrolled at colleges of education. Experience gained during this pilot program will provide us valuable information that may be useful to a broader set of colleges and universities in the future. The Learning About Science and Engineering Research (LASER) mobile teacher resource center was developed at the NASA Marshall Space Flight Center as a prototype NASA-industry partnership project. LASER brings NASA educational materials (e.g. teachers' guides, videotapes, software, slides, etc.) to those teachers not currently served by our existing teacher resource center network.

NASA is fortunate to have unique facilities to carry out its mission. NASA Select, our internal satellite video communications system, ties together all NASA Centers to provide communication in support of Space Shuttle missions and other NASA activities. While its primary purpose is mission support, this valuable resource can be used for education over extended periods. The footprint of our satellite system reaches all 50 states and is currently received by many cable TV systems as well as by those schools that have ground receiving stations. Soon, we will begin to utilize segments of the non-mission time on NASA Select for broadcasting existing educational and informational video tapes directly to teachers throughout our nation.

Our astronauts are seen as heroes and heroines by our nation's youth and their teachers. When visiting schools, astronauts can be excellent role models for children and adults alike as they relate their experiences and training. To use this resource strategically, I have created a new position for an

educational specialist to work collaboratively with the Astronaut Corps at the NASA Johnson Space Center to seek out educational activities that enhance the training of teachers, capture student interest, and channel more students into the science and engineering pipeline.

One final example: we have begun work on defining a "Classroom of the Future." NASA, in its unique position at the forefront of many technology areas, is seeking to identify, define and develop a classroom that will take advantage of the latest technologies and learning strategies in using aerospace concepts in the teaching of science, math and technology. It is our intent to demonstrate this concept and to encourage its features be replicated by other classrooms around the country.

Conclusion

In closing, let me say that our nation must stop reacting to educational problems with short-term solutions. We must and can prepare long term strategies. Today, scientists and engineers comprise only 4% of American workers, but projections are that more will be needed in the future and it is obvious that their specialized and scarce skills are vital to our national welfare. Furthermore, all young people from kindergarten through high schools should also be exposed to mathematics, science and technology even if they do not pursue careers in these areas.

We have no choice but to provide this knowledge if we, as a nation, and our students, as citizens and job-holders, are to participate effectively in our world. I can assure you that NASA can be counted on to do our very best to help alleviate the national education crisis. We intend to be a reliable partner in helping to implement the national education goals. We will continue to use our unique resources to conduct our aerospace education programs that capture student interest in science, mathematics and technology at an early age; channel more students into these career fields; and increase the knowledge, skills, and experiences of precollege teachers, college and university faculty and others.

Thank you.

DEPARTMENT OF VETERANS AFFAIRS

STATEMENT OF HON. ANTHONY J. PRINCIPI, DEPUTY SECRETARY

Senator MIKULSKI. Mr. Principi, you want to talk about the VA? Everybody would wonder, why would VA be at a science hearing?

Mr. PRINCIPI. I would be pleased to, Madam Chair, and I want to thank you for inviting us to this hearing and for giving us this opportunity to testify on a matter that, as Admiral Truly so aptly described, is fundamentally important to this Nation: math and science education.

VA ROLE HIGHLIGHTED

As you stated, many people may wonder why a Department like the VA would be called to testify. But as you indicated, when you look at the mission that we fulfill in math and education, we do, in fact, play a very prominent role, and I would like to briefly highlight for the committee what that role is and, second and most important, how I think we could do better.

Our Health Services and Research Administration, which administers the largest health care system in the world, is affiliated with 104 of our Nation's 126 medical schools and 850 affiliations with community colleges and universities across the Nation in training individuals in 2,000-some odd health care-related programs.

LEADERS IN RESEARCH

Each year 100,000 trainees, from high-tech medicine to computer technology, 2,500 scientists who are affiliated with the VA, are engaged in approximately $225 million in research. A short time ago I saw a commercial on TV where Dupont ran a rather dramatic ad depicting a veteran without a leg and how Dupont plastics made it possible for that veteran to play basketball. Well, what Dupont forgot to tell the American people was that the VA developed the Seattle foot, and we used Dupont plastics.

So we are the leaders in prosthetic engineering. But we also conceptualized the CAT scan. We are the ones that found that injecting steroids into an individual with a spinal cord injury shortly after the accident would dramatically reduce paralysis. And when doctors around the country said that hypertension could not be controlled, it was VA researchers and scientists who said it could be controlled and found the medication to do so.

So we are leaders in research, through your leadership, in tuition reimbursement, health scholarships, and tuition support. We must continue to outreach to the private sector to get these people more involved.

But also in the Benefits Administration, since the Congress first enacted the GI Bill back in 1946, VA has sent to school, mostly col-

lege, 20 million young men and women. But we do more than send out a check. We approve the schools, we approve the courses, we set minimum standards at those schools and for those veterans, and many of them are in science and math.

So the VA spends about $1.1 billion in education and research. But how can we do better? Well, certainly the VA now, as part of the Cabinet, as a member of FCCSET, needs to play a major role because we are major players in math and science education and research in America.

CALL FOR GREATER INTERDEPARTMENTAL COOPERATION

There needs to be much greater interdepartmental cooperation. We need a national strategy, and your leadership in bringing this diverse group together really points out the need for that strategy, not the kind of strategy that looks good framed and on a wall, but a meaningful strategy that calls out for greater cooperation amongst all of us key players at the other end of Pennsylvania Avenue.

But at the VA we have to do greater outreach to colleges and to high schools. We need to look at those standards at those universities and why some of those students are not doing as well in math and science and getting VA benefits.

So there is much that we can do internally and much externally, and I am pleased that our Department will play a role. Thank you.

Senator MIKULSKI. Terrific. You know, I think quite frankly when one thinks of the GI Bill and then the Montgomery Bill, and then also the benefits that have come out of the National Guard programs and Army Reserve, we are probably one of the biggest bankrollers of education that helped a lot of people who were middle class be able to stay there or do better and, but most of all, for a lot of people who would have never been middle class, this was an opportunity, earned and bought in patriotism, to get here.

Mr. PRINCIPI. That is very true, Madam Chair. And the universities and the community colleges need us as well, and therefore we should exert some leverage in setting those minimum standards to ensure that math and science education are at the top of the list and that the science is commensurate with keeping us on the cutting edge in world competition.

That is something we can do, because we are the ones that approve the schools and approve the courses, and I do not think in the past we have done a very good job.

Senator MIKULSKI. Excellent.

[The statement follows:]

STATEMENT OF ANTHONY J. PRINCIPI

Madam Chair and Members of the Subcommittee,

I am pleased to appear before you today to discuss the role of the Department of Veterans Affairs in our Nation's science and mathematics education programs.

When VA education programs are discussed, it is natural to focus on the various GI Bills that have educated over 20 million veterans since President Roosevelt signed into law the very first GI Bill of Rights. But in addition to education programs administered by the Veterans Benefits Administration (VBA), the Veterans Health Services and Research Administration (VHS&RA) is also deeply involved in a number of education programs. At this time, I would like to briefly discuss some of the major programs VA has in the area of science and mathematics education.

Montgomery GI Bill

Over 20 million persons have been enrolled in some form of GI Bill training since World War II. Statistics on the Vietnam era GI Bill indicate that about 11 percent of the recipients of benefits were enrolled in science and mathematics programs. The Montgomery GI Bill was enacted because Congress recognized the necessity of maintaining an adequate defense force. From the beginning of the program, almost 64,000 individuals have received training under the program. Most of those who have trained have done so at the college level - 59,690 out of 63,621, or 94 percent. While statistics are not available on the number of individuals enrolled in science or mathematics programs, it is clear that this program can be a useful tool in our Nation's educational strategy. In addition, close to 170,000 Selected Reservists have trained at an institute of higher learning under this program since its inception on July 1, 1985.

Affiliations

Currently, 139 VA medical facilities are affiliated with 104 of the Nation's 126 medical schools. More than 30,000 residents and about 22,000 medical students receive some of their training in the VA every year. These activities directly support the patient care mission of VA and assist in training health manpower for the nation.

In addition to academic affiliations with medical and dentistry programs, VA also has affiliations with other health care academic institutions. These associated health care professional categories include nurses, pharmacists, audiologists, dietitians, therapists, social workers as well as medical technologists, radiology technicians and other technologists among others. Academic affiliations can be either undergraduate or graduate programs. VA has about 2,000 affiliated clinical training programs with about 850 affiliated educational

institutions. These institutions include vocational technical schools, community colleges and four-year colleges and universities. These programs attract and retain health professionals and enhance the professional development of VA staff. When these associated health students are added to the residents and medical students, the number of trainees is approximately 100,000 per year.

Associated Health Professions Education Programs

The Health Professional Scholarship Program provides awards to nursing, physical therapy, and occupational therapy students for the final one to two years of study in a baccalaureate, professional master's, or specialty master's program. These scholarships are provided in return for a minimum service obligation of one year for each year or portion of a year for which the scholarship is provided. In 1989, scholarships were awarded to 350 nurses and 44 physical therapists.

The Tuition Reimbursement Program provides funding support for full-time VA employees enrolled in an accredited nursing degree program from associate to doctoral degrees. Participants may receive up to $2,000 yearly and have a one-year service obligation upon course completion.

The Tuition Support Program assists VA health care facilities in their recruitment and retention efforts for personnel in designated shortage categories. Support funds can be utilized for conferences, continuing education or academic course work related to each employee's job.

The Gerontology Nurse Fellowship Program is a two-year fellowship for registered nurses who are doctoral candidates initiating clinical research in geriatrics or gerontology. The program is designed to prepare expert gerontological educators, administrators, and researchers for leadership positions in the delivery of long-term care.

Medical Research

Our Medical Research Service supports the research of approximately 2,500 VA scientists, 75 percent of whom are physicians. Of special interest to this Subcommittee is the Career Development Program which supports approximately 240 clinician-scientists who spend the majority of their effort on medical research during the award period. At the entry levels, Associate Investigators and Research Associates work under a senior scientist preceptor and are trained to become independent investigators. The Clinical Investigator is an independent scientist at the Associate Professor level; the Medical Investigator at the full Professor level. There are five Senior Medical Investigators including two Nobel laureates. Participation in the Career Development Program is highly competitive and only 30-40 percent of approved applications can be supported.

Close

Madam Chair, in closing, I want to stress that VA enthusiastically supports the Administration's goals in science and mathematics education. We look forward to working with the Federal Coordinating Council for Science, Engineering, and Technology as a member of their Committee on Education and Human Resources.

This concludes my statement. I will be pleased to answer your questions and those of the Subcommittee Members.

ENVIRONMENTAL PROTECTION AGENCY

STATEMENT OF F. HENRY HABICHT II, DEPUTY ADMINISTRATOR

Senator MIKULSKI. Mr. Habicht, let us hear now from EPA.

Mr. HABICHT. Thank you, Madam Chair. I also have to applaud you for bringing this diverse group of agencies together.

One of these days we are going to get the message and get our own act together with respect to education needs, and I think that you have heard today that we are on our way to doing that.

Bill Reilly sends his regards. As you know, he would be here personaliy, but he is over in London in the final phases of negotiation of a treaty to deal with the stratospheric ozone problem that you are very familiar with. I think we would not be as far as we are without the kind of scientific and engineering minds in both the private sector and the Government that were able to come to grips with this problem and come up with a creative approach to deal with it.

Well, you have heard eloquent descriptions of the kind of problems that we face with regard to our capacity in developing math and science expertise. We are very committed to coordination. I want to briefly give you a sense for EPA's perspective on this issue.

SYNOPSIS OF EPA STATEMENT

As we discussed on a number of occasions, Madam Chair, EPA is in the process of developing a strategic plan. We are trying to determine where the Agency needs to go in the next five to ten years. We need to integrate our own activities to get a sense for what the priority risks are and what kind of role EPA can most constructively play in developing an environmental protection scheme that will take us into the next century.

We, as you know, are traditionally a regulatory standard-setting agency. One thing we have clearly concluded is that the kind of problems that we are dealing with are so complex and interrelated and pervasive that we cannot do it through traditional regulation alone.

EXPANSION OF MISSION CRUCIAL

Our mission has to expand. We have to integrate our functions and integrate environmental protection into the rest of human activity. Science and math education are going to be critical. The delivery of information, technology transfer, and basic education are tools that are going to allow us to achieve sustainable development, and regulations alone just will not do it, though they will still be very important.

There are several reasons why science and math education are important from our own parochial standpoint as well as from the

standpoint of what is good for the American public. First of all, as you know, our success as an agency depends on having first-class scientists. Over one-third of our work force are scientists and engineers, and that work force is depleting rapidly with retirements, and we do not have a lineup of the kind of people that we need to have to replenish these ranks and to grow.

Second, our job at EPA is to encourage innovation in the private sector and the regulated community, so that we can figure out, which I think we can, how to grow economically and technologically as a society, but to do it in an environmentally sound way. We have to have the best scientific and technical minds in the world to help us to accomplish this goal.

Third, and most importantly, as you well know, and you are very much a champion of this issue, the best regulations and the best Federal programs in the world will not allow us to achieve sustainable development, which is a goal we all share, unless we inculcate in the public a basic environmental literacy, beginning at kindergarten and even before kindergarten, with regard to the kinds of choices that everyone makes that affects the environment.

So environmental literacy, basic environmental literacy, is critical to our success.

THREE KEY ELEMENTS

Let me now describe three key elements, three key prongs, of what we are doing as an Agency and are committed to do in the years ahead with your support and cooperation. First of all, we are committed to do our part to work in this interagency process in FCCSET and PCAST, the kind of process that you have heard described, so that the Federal Government really does get its act together and has its resources deployed in the most effective way.

We are committed to contribute people, time, and effort to a coordinated strategy, the kind that Dr. Bromley described, and to work closely with Secretary Watkins through our laboratories and other facilities.

Apropos of Senator Kerrey's question, we do not have a national delivery mechanism. We have labs and regions in certain parts of the country, but we want to make sure that these services and what EPA can offer are delivered.

Senator MIKULSKI. Excuse me. You said you do not have what type of mechanism?

Mr. HABICHT. A national delivery mechanism that hits every community in the country.

Senator MIKULSKI. Are you talking about EPA or are you talking about——

Mr. HABICHT. I am talking about EPA.

Senator MIKULSKI. OK.

Mr. HABICHT. This is why we need the interagency coordination.

Second, at the university and postgraduate level, EPA has to do a better job of increasing scientific interchange, the kind that NSF and NASA have done so well over the years, with universities, with scholars. We want to increase demand in the student population for getting into undergraduate and postgraduate research in the environmental sciences.

So we have increased our exploratory research grants in the 1991 budget, as you are well aware, by 60 percent. We are also increasing the number of cooperative ventures we have with universities, like the University of Pittsburgh, for example, in developing environmental technologies. We also have internship programs and visiting scholar programs I will not detail here in the interest of time.

We have a number of research grants that we have earmarked for students in universities around the country dealing with questions that EPA addresses. We take applications. We have over a million dollars that we have committed to 191 projects for university students.

The third element of our strategy, however, goes to the most fundamental task that we have ahead of us, and that is reaching the K through 12 community and inculcating environmental literacy and interest in science and math and technological education at the earliest possible ages, and in using grassroots organizations to help make this happen.

ENVIRONMENTAL EDUCATION TASK FORCE

We are making a major commitment to environmental education. As you well know, 6 months ago we set up an environmental education task force that has been developing a strategic plan for us, a plan that will be ready to deliver to you at the end of July.

It develops a game plan for what EPA needs to do to pull together its various activities in education. Already, on June 15, we announced the creation of an Office of Environmental Education at the Agency to coordinate the activities of our regions, labs, and offices around the Agency.

Our basic goals are to make science more popular, to make science fun, to capitalize on the kind of interest we have had in Earth Day among all people, to use science in the way we make individual choices, and to encourage people to get into science and environmental careers.

TOOLS UTILIZED

There are a number of tools that we use, and we detail this in our testimony. One way to get to people around the country is through conferences. We recently held a youth environmental action forum here in Washington. Marylouise Uhlig and Mike O'Reilly, who are with us here today, were instrumental in putting that together.

We had students from every State in the country, educators, people from around the world. That begins to develop a network. You can have the best delivery mechanism in the world, but you need to get to kids and have kids be our ambassadors, and this is a way to get that started.

All of our programs have educational tapes. We worked with General Motors on an educational tape called "I Need the Earth and the Earth Needs Me." That tape, principally through GM's auspices, was distributed directly to 75,000 primary schools around the country.

We have awards programs for youth. We need to provide incentives. We need to make our facilities and our people available to

show what science can do in the real world to protect the environment. And we are really having an effect.

We are working with the Tennessee Valley Authority in setting up electronic data links around the country in a network of environmental centers.

I want to just mention briefly, there are many programs that we can get into based on your questions. We are increasing grants to high schools and secondary schools to start to develop people to join EPA's work force and to develop the environmental sciences.

DISADVANTAGED AMERICANS

I will now spend a moment telling you what we are doing to help disadvantaged Americans, both in inner cities and rural communities. We have a number of fellowship and grant programs targeted at women and minority students to bring them into environmental science careers. We also have minority research apprenticeship programs with several of our labs.

Around the country, our facilities have adopted inner city and disadvantaged schools, and are providing a lot of technical assistance to them.

Let me close now so that we may get to your questions. I think it is important, Madam Chair, that we not only use our facilities for education purposes, but that we build bridges to the private sector and to grassroots groups around the country. There is much that we can fill you in on in that area, including activities in Baltimore such as the creation of a Natural Guard facility under the direction of Richie Havens, who we have been working with.

In short, science and technology education has a much higher priority at the Agency, not only because it is important to the country, but because now we realize that it is a fundamental part of our mission.

As I sit next to the Administrator of NASA, I cannot help but think of a way the Wright brothers' first flight was described, as "breaking through the smokescreen of impossibility." We have reason to be hopeful that we can solve the kind of environmental problems that have a lot of people depressed and concerned. Bill Reilly and I have great hopes.

But the only way that we are going to achieve the kind of solutions that we need to achieve is to create this environmental literacy and to continue to develop the best scientific and technical minds in the country. It will take cooperation among our agencies and particularly cooperation between the executive branch and Congress, and we are committed to that.

Thank you very much.

[The statement follows:]

STATEMENT OF F. HENRY HABICHT II

Madam Chair and Members of the Subcommittee, thank you for the opportunity to appear before you this morning to discuss the development of the President's strategy to meet the Nation's science and mathematics education challenges. The problems that we face with respect to science and mathematics education are pervasive and well documented. Administrator Reilly and I, as well as the rest of the EPA team, are particularly sensitive to this issue because of the large role that scientifically trained personnel play in the fulfillment of the Agency's mission and in ensuring the soundest possible scientific basis for the significant decisions we make.

More fundamentally, we view EPA support of better math and science education in all sectors as important to society's well-being. As you know, we are working in a strategic planning process to integrate EPA's activities and to ensure that EPA programs encourage prevention of pollution -- and more innovative technologies and processes that will ensure that environmental protection can be achieved totally consistently with robust economic and technological advancement. EPA can't prescribe such innovations; we count on each well-trained citizen to contribute to them. You are hearing today from those agencies that have diverse missions but a strong shared sense of the need to help ensure first-quality training in science and technical disciplines.

As you know, we recently celebrated the 20th anniversary of the first Earth Day in 1970, and are quickly approaching the 20th anniversary of the establishment of EPA. Earth Day was the event that, more than any other, galvanized the modern day environmental movement and gave expression to the strong desire of the American people for a clean, healthy, productive

environment. As a nation, we have accomplished a great deal since that historic outpouring of environmental concern 20 years ago. Unfortunately, many of the environmental problems that sparked the first Earth Day are not fully resolved, and others have yet to appear. New, more difficult, more complex problems demand our attention and all the ingenuity and dedication that we can muster. Because the best resources that we have to respond to these problems are our citizens, whether at the national, state or local level, it is critically important that our young people have a strong foundation in science and math.

Education Shortages

You have already heard extensive testimony this morning that our education system is unable to ensure quality replacements for our scientific workforce. Studies have shown that U.S. students are no longer competitive in the areas of math and science with students from other parts of the world. This trend is sobering for those of us charged with protecting the environment. Though environmental scientists and engineers comprise only approximately four percent of the scientists and engineers presently employed in the United States, we expect that in the years to come there will be a greater need for environmental scientists with special technical and scientific training.

EPA is facing a critical and potentially crippling shortfall of its technical workforce in the 21st Century. Impending shortages of scientists and engineers, compounded by the relative absence of women and minorities in these fields, threaten the Agency's ability to effectively deal with important environmental problems facing the Nation.

As we develop a strategic vision for the next several years it is more clear than ever that we need strong science to support decisions and promote more innovative, preventative solutions to

environmental problems. EPA, by definition, must be a leader among science agencies for addressing national and international environmental issues. As political leaders and the public continue to recognize the urgency and global nature of environmental challenges, EPA will be required to respond with high quality research, innovative analysis, and sound strategies for public involvement. Therefore, the Agency has a vested interest in assuring that students emerging from the education "pipeline" are math and science literate and that the country produces an adequate supply of world-class scientists and engineers.

However, the scientific and technical workforce on which the nation has so heavily relied upon for two generations is eroding. Experts now predict that the shortfall for professional scientists and engineers in America between now and the year 2000 could be as much as half-a-million people.

EPA will have an increasing demand for scientific and technical professionals in the future. EPA's workforce, overall, is highly educated. Over 68 percent of the Agency's employees have at least a bachelors degree -- more than double the government average. Over one-third of EPA's 15,000 employees are scientists and engineers -- a proportion that has been constant over the last ten years. With an annual turn-over rate of 11 percent, combined with the fact that EPA's scientific and engineering personnel are older (averaging 50 years of age, compared with the Agency overall average of 39), the Agency stands to lose a significant percentage of its technical work force within the next ten years.

Federal Initiatives

A major priority of President Bush is improving the often poor historic coordination of Federal agencies. Dr. Bromley, Admiral Watkins and others are truly making that happen in the

subject area before us today. Dr. Bromley has outlined the Administration's overall view on the importance of developing and maintaining a well-coordinated interagency Federal program in support of science, mathematics, engineering, and technology education to achieve the desired result. The principal mechanism for accomplishing this goal is the new Committee on Education and Human Resources within the Federal Coordinating Council on Science, Engineering and Technology (FCCSET). FCCSET is the interagency group within the Executive Office of the President that is charged with reviewing, integrating, and coordinating the cross-cutting science, engineering, and technology activities of the Federal agencies. Administrator Reilly and I strongly support the FCCSET initiative because of its potential to assist in the formulation of uniform scientific and budgetary decisions.

EPA has participated in all of the FCCSET planning meetings to date and has witnessed firsthand the potential success of the Committee for coordinating multi-dimensional, cross-cutting areas of science and technology. The U.S. Global Change Research Program was organized under the auspices of the FCCSET Committee on Earth and Environmental Sciences in an attempt to coordinate the global research efforts of several agencies, including EPA.

Seven new committees have been formed by FCCSET to oversee broad areas of science and technology. EPA's Assistant Administrator for Research and Development, Erich Bretthauer, is the Vice Chair of the Committee on Earth and Environmental Sciences. The new Committee on Education and Human Resources, chaired by Secretary Watkins, is currently reviewing Federal research and development and support programs directed at improving education, training, and human resources development in math, science, engineering, and technical education. Lew Crampton, the EPA Associate Administrator for Communications and Public Affairs, represents EPA on this workgroup.

EPA is an enthusiastic supporter of Secretary Watkins' plans to assist States and local communities in achieving the National Education Goals developed by the President and the Governors. We stand ready to supplement Secretary Watkins' efforts through the use of EPA's twelve national research and development laboratories. Like DOE's facilities, EPA laboratories could be used to conduct a range of precollege and university science education programs which would vary by laboratory.

In addition, we believe that new links need to be forged with universities in areas such as developing better technologies to reduce risk. Programs currently underway include the National Environmental Technology Applications Corporation (NETAC), a joint effort with the University of Pittsburgh to assist businesses in evaluating technologies and in formulating business plans, and cooperative agreements with academic institutions and private individuals pursuant to the Federal Technology Transfer Act (FTTA) to promote the research and commercialization of new technologies.

Environmental Education

Since his Inaugural Address, President Bush has urged the American people to embrace a new ethical awareness of nature and our responsibility for its stewardship and wise use. During the first year of his presidency, he launched solid, wide-ranging environmental initiatives -- in such areas as international leadership, advocating a goal of no net loss of wetlands, sweeping proposals for strengthening the Clean Air Act, and stepping up Superfund enforcement. In January, he announced his support for elevating EPA to Cabinet status. The Administrator and I admire and share the President's abiding interest in renewing this nation's commitment to conservation of the natural resources on which all human activity, including economic activity, depends.

Heightened public sensitivity to the environmental consequences of individual and collective actions is a benefit of environmental education. Additionally, it is through environmental education that we can help prepare future environmental management professionals. Recently introduced, S. 1076, a bill "to increase public understanding of the natural environment and to advance and develop environmental education and training," seeks to achieve these same objectives:

- o expanding and improving public understanding of environmental problems;
- o fostering environmental education and training programs at the State and local levels; and
- o encouraging young people to pursue careers in environmentally-related scientific and technical fields.

EPA supports the principles of environmental education legislation such as S. 1076. One of the major features of the bill is its recognition of the need for college-level training in the environmental sciences, and it proposes an internship program to further this aim. We at EPA are especially aware of the need to ensure the presence of an ample supply of trained and qualified professionals in scientific and technical environmental fields both now and in the future.

S. 1076 further proposes to establish an Office of Environmental Education within EPA to coordinate environmental education activities within the Agency and those conducted by other Federal agencies, and to foster environmental education programs at the State and local level. In fact, in light of the

growing need to coordinate Agency environmental education activities, Administrator Reilly announced on June 15 the creation of EPA's new Office of Environmental Education, which is being set up under the direction of the Associate Administrator for Communications and Public Affairs. This office will bring into closer focus several existing programs within the Agency, as well as coordinate with similar activities in other Federal agencies, in State and local governments, and in the private sector.

As we have previously testified, while EPA strongly supports the underlying principles of this legislation, we do have several concerns about specific provisions of the bill. In particular, we strongly object to provisions in the bill to set aside Federal monies in a trust fund for funding the activities contemplated by the bill, and we would be opposed to any requirements for direct EPA involvement in the area of educational curricula and development.

Last November, Administrator Reilly and I established, within the Agency, an Environmental Education Task Force. This group was charged with three major responsibilities:

- o To develop a blueprint or strategic plan for EPA's involvement in environmental education;
- o To track the progress and movement of related legislation; and
- o To plan and conduct a Youth Environmental Action Forum

The work of this Task Force is almost completed. The strategic plan outlining the Agency's involvement in environmental education is expected by July 30.

The Youth Environmental Action Forum was held last month in conjunction with the National Governor's Association, and accomplished its purposes of disseminating information about EPA's efforts; encouraging careers in environmental science and related areas; and developing a network of young people, teachers and Governors, dedicated to spreading the "environmental work" in their individual communities, schools and states.

President's Awards for Excellence in Environmental Education

At the beginning of June, Michael Deland, Chairman of the Council on Environmental Quality, sent up legislation on behalf of the President to establish the President's Awards for Excellence in Environmental Education. The proposed annual program is designed to stimulate innovative teaching methods for environmental education. The awards would recognize elementary and secondary school teachers who make a positive impact on students and their communities by incorporating environmental themes in their course offerings. Two teachers from each state and one each from the District of Columbia and Puerto Rico would receive awards. The program is intended to strengthen environmental literacy and an environmental ethic as well as to reinforce opportunities which expose students to the variety of career skills needed to solve environmental problems.

In addition to these efforts, EPA is also involved in several other environmental education initiatives:

Minority Institutions Assistance (MIA) Program

EPA, through its Office of Exploratory Research, operates a special program to provide Federal assistance to minority institutions. The MIA program was initiated in 1981 to increase support for eligible minority institutions and to provide fellowships for students attending these institutions. The program has three separate components: a Research Assistance

Program for faculty; an Undergraduate/Graduate Fellowships Program; and a Summer Intern Program for students who have successfully completed the Student Fellowships Program. The Student Fellowship Program is particularly noteworthy for purposes of today's discussion because its objective is to encourage students to develop careers in environmental research via the environmental sciences, engineering, biological sciences, physical sciences, computer sciences, and mathematics.

This initiative is of particular importance when we consider the Department of Labor's projection that by the year 2000, minorities and women will comprise the majority of new entrants into the workforce. We realize the crucial need to begin to interest ALL students in environmental careers.

Along this same line, EPA is also currently exploring the possibility of assisting in the development of a graduate-level fellowship program for environmental science and management.

EPA's Center for Environmental Learning

The Center is located in the Agency's Region III Office in Philadelphia and sponsors environmental lectures featuring prominent speakers, forums, and seminars. These sessions, both within EPA and throughout the mid-Atlantic region, focus on issues such as waste minimization, SARA Title III, air toxics, risk analysis and communication, indoor air pollution, environmental education trends, and dispute resolution. In the future, the Center plans dialogues on key issues among educators, nonprofit organizations, industry, and other constituencies.

National Advisory Council for Environmental Policy and Technology (NACEPT)

The National Advisory Council for Environmental Policy and Technology was established at EPA by Federal charter in June 1988. The Advisory Council consists of a group of independent

experts drawn from government agencies, business and industry, academia, public interest groups, and the media. This group advises the EPA Administrator on technology and policy issues associated with environmental problems.

NACEPT's Environmental Education and Training Committee, one of five standing committees, has as its goal the achievement of an environmentally conscious and responsible public. Last September, there were national hearings that solicited testimony and recommendations from over 40 national and international experts on the state of environmental education generally and how the Agency might best proceed in the next decade. Overall, these recommendations have provided a valuable resource from which we are drawing ideas to build our environmental education program and strategic plan.

EPA's President's Environmental Youth Awards (PEYA) Program

The President's Environmental Youth Awards Program offers young people an opportunity to be recognized for their efforts to protect our environment. Students from kindergarten through grade twelve can participate as individuals or as part of a class, school group, youth club, or summer camp. To be eligible, a student must plan and carry out an environmental project and must be sponsored by an adult who will advise and guide the student(s). President Bush awarded this year's PEYA participants certificates and honored ten national winners in a White House ceremony last November.

National Network for Environmental Management Studies (NNEMS) Program

The National Network for Environmental Management Studies Program is a cooperative effort of EPA and over 75 participating universities designed to produce high-quality graduate studies in environmental policy and management areas where the Agency has

identified a real need. The Agency's identified needs are translated into research questions. Graduate students from any participating university are invited to submit written research proposals to EPA which, if accepted, are funded by the Agency. NNEMS provides real world experience, learning opportunities, professional guidance, and encouragement to individuals pursuing careers in environmental protection fields. The Agency benefits by receiving completed priority research projects, identifying high quality recruits, and increasing public awareness of environmental problems. The research is disseminated to a national audience of public and private professionals and organizations in environmental management fields.

Making A Difference -- Relevant Environmental Education

As one example of EPA Regional involvement, our Region X Office in Seattle has initiated a pilot project that uses local environmental issues as a tool for illustrating the interrelationships among academic subjects and to help students understand their role in protecting the environment. The project has three elements: to develop an integrated environmental curriculum; to demonstrate resource potential of schools; and to show young people that they can make a difference.

Last fall, I formed a National EPA Pollution Prevention Environmental Education Task Force. This group, composed of representatives from all EPA Regions, is charged with coordinating and working with Federal, state, local, and private sector education experts to develop pollution prevention education materials for teachers and students. In full-swing later this year, we see this project as being a model for our future national environmental education efforts.

In conclusion, I applaud the Subcommittee and you, Madam Chair, for your leadership and initiative in helping to improve

science and mathematics education to reverse current trends. A proper science and mathematics education is crucial not only to our national security and economic viability, but to our very quality of life. I know that Administrator Reilly joins me in expressing EPA's wholehearted commitment to the realization of our mutual goals. We both look forward to working with our sister agencies on the initiatives outlined this morning, as well as with the Subcommittee and staff on additional ideas.

I would be pleased to answer any questions you may have.

CABINET PEOPLE LAUDED

Senator MIKULSKI. We thank you for the excellent testimony from all of the witnesses.

First, I would like to say something about President Bush. I think he has provided an excellent group of Cabinet people to work with, and as each one of you has talked about your agency missions, we can see that his program is highly consistent with our goals. So we have a partnership in a national program for science, math, and education.

We are not at odds here. It is not like budget and taxes, and I will not bring that up. But I really do feel that the President has provided excellent Cabinet members and deputies. That is why I have such enthusiasm.

The second point I want to make as I go into a couple of questions is that no one wants you to give up your mission. You have a mission of cleaning up the environment, to take us into space, to help our veterans who need our commitment. But we feel that education is a part of the mission, one to get our country ready to face the future work force readiness issue, and we are so glad you see the linkages.

I have been particularly impressed, for example, with NASA and the way it has worked with the Community College Program, in which at Brevard I saw people one generation away from being migratory workers in a space tech program, people at midcareer, late twenties, early thirties, displaced homemakers, in Brevard's night school program being taught by a private contractor person who loved not only his job and working in the space program, but loved getting people ready for the space program, and they are working on the tile project.

I could go on into other examples. So we look forward to working with you.

MISSIONS AND FACILITIES THAT EXCITE KIDS

You have 172 hospitals; you have 7 centers; you have 14 labs. I think we could revolutionize America, for unlike the people at the Department of Education, we have the missions and facilities that

excite kids. Doing things with their hands—I mean, look at you. Are you not happier, Admiral, when you are out there with your astronauts and you are peaking to see how Voyager is doing today?

And EPA, why, they would much rather be with me at a wetland meeting than at an OMB meeting. [Laughter.]

For all kinds of reasons.

But we are intrinsically people who like to do concrete things, and so do our children. It is through your agencies that you are the biggest recruiters of people interested in science. You make it live, you make it work, and you make it possible. They can see that.

Somebody right now whose mother might be on public assistance knows her daughter can get into the Essex Community College and get a nursing degree and maybe work at that new hospital we are going to be opening in Baltimore. The Brevard people, your laboratories in the small towns that Bob Kerrey is worried about—Athens, GA, so on.

EDUCATION COORDINATORS

So having said that, I want to ask just a few questions. First of all, EPA has an education coordinator.

Admiral, you have an education coordinator, is that right?

Admiral TRULY. Yes.

Senator MIKULSKI. You do in Mr. Brown.

Mr. Habicht, is your education coordinator brand new?

Mr. HABICHT. Yes; we are in the process of creating an office of environmental education under the direction of Lew Crampton. That is basically a new post.

Senator MIKULSKI. Well now, how do these gogetters fit into that, the people that you have introduced to me that do all these wonderful things in the field, that are nodding every time I say something? [Laughter.]

The ones that we want to increase their GS level by three.

Mr. HABICHT. Absolutely. They are gung-ho. They have delivered a lot with limited resources while helping to create a new program. They work with Lew Crampton. They put together the youth environmental action forum. They have helped to put together our environmental education strategy.

These are the people that put it together.

Senator MIKULSKI. So they would be in Mr. Crampton's shop if that is the case?

Mr. HABICHT. For the most part; yes.

Senator MIKULSKI. Did you tell me that creating is a violation of reprogramming?

Well, you know what? I view it as like visiting a chiropractor: You are coming into alignment. [Laughter.]

So we will be OK there.

What about VA? Do you have a designated education program or manpower area?

Mr. PRINCIPI. Yes; on the health care side of the house, of course, we have an Associate Chief Medical Director for Academic Affairs. We have an Associate Chief Medical Director for Research. On the benefits side, we have a Service Director for Education and Vocational Rehabilitation.

So we do have three principal coordinators, if you will, who oversee our education and training programs.

Senator MIKULSKI. Do you feel you need to centralize that?

Mr. PRINCIPI. Well, their missions are so different, Madam Chair. Of course, on the health care side of the house and the benefits side of the house, it really comes up through our Chief Benefits Director and Chief Medical Director to me. I think it is centralized fairly well.

DOCTORS TRAINING DOCTORS

Senator MIKULSKI. Well, one of the things that we will want to talk about within the medical program, in all due respect there is a subculture to medicine where doctors are interested in training doctors, is the lesser focus on the other people needed to make your fine facilities work. And we would hope that there would be an added dimension or a person focused on the vocational technician and therapist community. Am I right in that?

Mr. PRINCIPI. Yes; you are, Madam Chair. There is always an emphasis by the doctors to train doctors in high-tech medicine.

We have established a very high level advisory committee. This one has to do with research, but it really gets to that issue, to take a look at how our education and research dollars are being spent, in what areas, the mix, the quality. And we are looking forward to those recommendations.

But yes, that balance needs to be.

NURSING SHORTAGE

Senator MIKULSKI. Well, and I think they need to feel the urgency. In visiting the Baltimore facility with you that day, we talked to Barb Gallagher, who is an excellent administrator. Also at Fort Howard, our place in Maryland that is a long-term care rehab facility, we had to bring nurses from Puerto Rico to Baltimore to work in VA.

They are doing a fine job, a fine job. So that is not a criticism of that. But it highlights that in a major urban area that is educationally rich that we are facing a nursing shortage, which shows the need for that type of focus.

Let me ask a couple of these questions. One, do you need particularly additional resources to be able to flesh out your rather fine and ambitious goals in the areas of education?

What about you, Admiral Truly?

LEVERAGE PROBLEM

Admiral TRULY. Thank you for asking me that question. I would first say that, even though we have talked a lot about good programs that these three agencies do, the job is still so big, the challenges are so large, that I want to remind myself and the committee that I see our biggest problem in our educational programs in leverage.

In other words, we have good programs. We have developed curricula for second graders. We have developed videotapes for par-

ents of preschoolers. We do this, do that, and we have good programs.

But we do not have the ability to get them to all the schools in a timely manner, and we do need resources. And there is an issue, as a matter of fact, that is going to come to this appropriations subcommittee this year in a portion of our request from the House Appropriations Committee, that asks for a limited amount of new resources, that needs you to deal with it and help us deal with it.

I would say that our biggest challenge in doing better is leveraging, and it gets down into printing costs, moneys to run TV programs to get into schools.

I would say that Dr. Brown's biggest problem is that the NASA Administrator is pushing him so hard for us to do better, even with the programs that we have today. We are doing our best to internally coordinate, frankly, a limited number of very excited people, not at NASA headquarters, but all of our centers, to get this leveraging effect.

It is not a large request, but I think it is of most importance.

Senator MIKULSKI. Mr. Principi.

FUNDING SHORTAGE

Mr. PRINCIPI. Madam Chair, we could always use more money. This committee, you in particular, have been very generous with us, especially in the scholarship and training area, and even when I wanted to reprogram some dollars out of one scholarship program——

Senator MIKULSKI. I know, but you were new.

Mr. PRINCIPI [continuing]. You made it very clear to me that I could not do that.

On the benefits side of the house, in administering the GI Bill we have about, we are going to be growing to about 500,000 veterans in school and college here in the next few years under the new Montgomery GI bill. Administering that program, I think we could use more people as we look at the standards, the courses, the curriculum, approving these schools.

We have spent tens of billions of dollars in this education program over the past 40 years and I am not convinced that we are doing a very good job. I think we have to do better, and I think that is going to take some resources on the benefits side in our GOE account. I could work with staff on that issue, identifying what we need.

Senator MIKULSKI. We will look forward to that.

Mr. Habicht?

Mr. HABICHT. Well, first of all, Madam Chair, as Dr. Bromley said, I think it is important that the executive branch hold up its end of this relationship better than we have in the past. And what is going to result from the 1992 budget will be a coordinated Federal budget involving these kinds of education issues. We will be very much a part of that effort, much as was done with global change research, and I think that is a very good process.

Second, like the other agencies, this really is the first year we have focused on this issue the way that we have, and I think we have many relevant activities going on around the Agency that we

are pulling together. But we are finding that, rather than simply creating a whole separate program—and just for the record, we have not yet created the Environmental Education Office, and, when we do, we certainly will work with you through the appropriate procedures to accomplish that—we are bringing all of the Agency's education-related activities under one umbrella which will enhance their effectiveness.

There also is, as you know, an Environmental Education Act that is moving through the Congress, that may have budgetary implications.

MOTIVATION NEEDED

But my main observation to add to what has already been said is that our people are extraordinarily excited about, as part of their other responsibilities, getting involved with schools and educational activities, and so we very much want to build this way of thinking into the organization, rather than create a dramatic new bureaucracy to do it.

We want to make sure it is coordinated, but it is something that invigorates our employees, and I think we can do it largely through leverage and existing resources, though we may well come back to you in 1992 and want some more.

Senator MIKULSKI. Well, first of all, I appreciate the fact that no one wants to create additional bureaucracy, but designate areas where there can be coordination—first of all, inspiration, and then coordination, and then some accountability.

We look forward to working with you. There could be many questions that we could ask. The time is growing late. We appreciate your efforts, and I wanted to just share with you a bill that I am working on that I think could help your employees help our country.

NATIONAL SERVICE

I have been a strong advocate, along with Senator Sam Nunn and Senator Kennedy, on national service. We have a bill going through that includes opportunities for full-time service and part-time service, where kids can earn a voucher used to reduce student debt or towards first-time homeownership.

It would work this way. Let us say someone has worked in my part-time program, which I am the architect of. It is modeled on the National Guard, which is people go to work, go on with their relationship, whether they are working for VA or Ford Aerospace, or whatever. But we would ask them to give 2 weekends a month or the time equivalent working primarily in nonprofit organizations, for which they would then earn a $2,000 voucher that they could use to reduce their student debt or would be held for them like a housing IRA toward first-time homeownership.

They would get a voucher for up to 3 years, no more than that. Under this program, for example, one of your people working in your laboratory could actually be out working with the Scouts. You could earn my voucher or the Congress' voucher, working in Scout programs, or working after school with science clubs.

I envision, for example, out of your incubator of agencies we could be running science fairs in neighborhoods that do not have them now. We could be running Saturday scholar programs, where they are not taking from your work. They would be doing it in the evenings, they would be doing it on weekends.

We would hope three things would happen: one, we help them with the enormous amount of student debt that so many of your employees bring to the agency. Difficulty in recruitment and salaries, is it not, the amount of debt they have? That is No. 1.

No. 2, that they develop the habits of the heart that make our country great, so when the voucher is done they keep on volunteering.

And No. 3, they inspire a whole number of other people and help a whole number of other people who have not had the benefits of some of our fine programs. And in this way, I think we have a multitude of partnerships and leverage that we are talking about.

So we thank you for your participation today. I know it went on a little long, but we are going to continue working with you. We thank you for your cooperation with both the President and this committee.

CONCLUSION OF HEARING

This concludes our math and science education hearing. This subcommittee will stand in recess until the call of the Chair. Thank you.

[Whereupon, at 12:04 p.m., Thursday, June 28, the hearing was concluded and the subcommittee was recessed, to reconvene subject to the call of the Chair.]

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